EDITORIAL

RIGHT now, in the field of electronics, there is an almost chronic shortage of "skilled" labour. This is due in part to the demands of television but, on a wider scale, it is the inevitable result of the penetration of electronics into so many branches of modern industry.

Men who "cut their teeth" in radio have gravitated into fields far removed from communications and domestic entertainment. They form the vanguard of a whole new generation of engineers trained to think in terms of the ubiquitous electron.

The many students who, over this Christmas period, will be faced with the responsibility of choosing a career, should consider carefully the electronics field. It is a fruitful and fascinating field, one with horizons unlimited. As one overseas expert put it recently: "Electronics is the child prodigy of modern industry."

But let me strike a note of warning. The shortage of technical personnel, which I mentioned earlier, has led to a kind of bonanza, which is painfully apparent to employers, at least.

I hear the constant complaint that men with little background have to be paid out of all proportion to their skill, relative to tradesmen in other branches of industry. And because, just now, a little knowledge goes a long way, it is all too easy to be content therewith.

But "a little knowledge" gives no guarantee of security. By familiarity, a man may become quite proficient at a certain job. He may be able to fix faults in television receivers with the best of them—but lack the background to tackle anything much else. I fear that many are currently finding themselves in this very unhappy position.

In other words, it is no longer sufficient to rely on "the hard school of experience." The men to succeed in the field of electronics will be those who submit to systematic training and study; who build a foundation of basic knowledge, to be broadened later and maintained by experience on the job.

My advice to younger readers is therefore to consider carefully a possible career in electronics but to beware of "short cuts." Whether at trade, diploma or degree level, lay the very best foundation you can—and keep right on building!

Finally, may I express to readers generally, sincere Christmas greetings on behalf of the staff of "Radio, Television and Hobbies." After the vicissitudes of the past year, we are looking forward to big things in 1961.

W. N. Williams

INDEX

	Page		Page
Eyes Play Dangerous Tricks	3	Stereo With Transistor Amps.	60
Man-Made Mirage	4	Sun-Powered Receiver	75
Pulses Spot Line Faults	8	Here's Your Answer, Tom	78
Flight Paths in 3-D	11	Design for a Valve Tester	84
Scents for Milady	12	Amateur 3-Band Converter	95
Meter Measures Humidity	17	Let's Buy an Argument	102
Review — High Speed Camera	21	Book Reviews	107
Review — Powerful Valve	23	Trade Reviews	109
Review — Micron Valves	25	Off The Record	114
Scientific, Industrial News	27	In Review—By Julian Russell	121
The Q6er for SSB	30	Australian Radio Stations	128
How Transistors Operate	42	Amateur Bands—Bill Moore	130
Amplifier Level Indicator	52	On Shortwave—Art Cushen	135
The Serviceman Who Tells	55	Answers to Correspondents	138

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OUR COVER PICTURE

What boy can resist a working model? Geoffrey Ambilino, 7, from Middlesex, studies a model of a Birmingham City Corporation tramcar. It was shown at a recent display sponsored by the Tramway and Light Railway Society.

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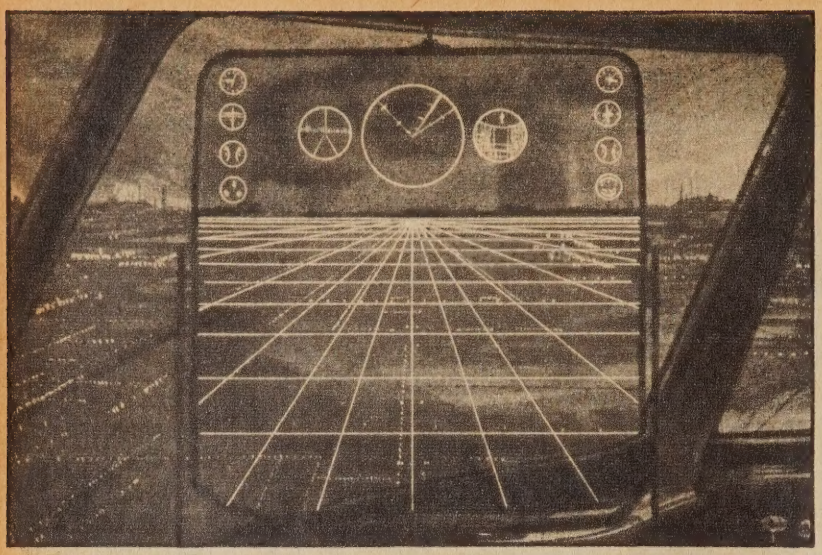
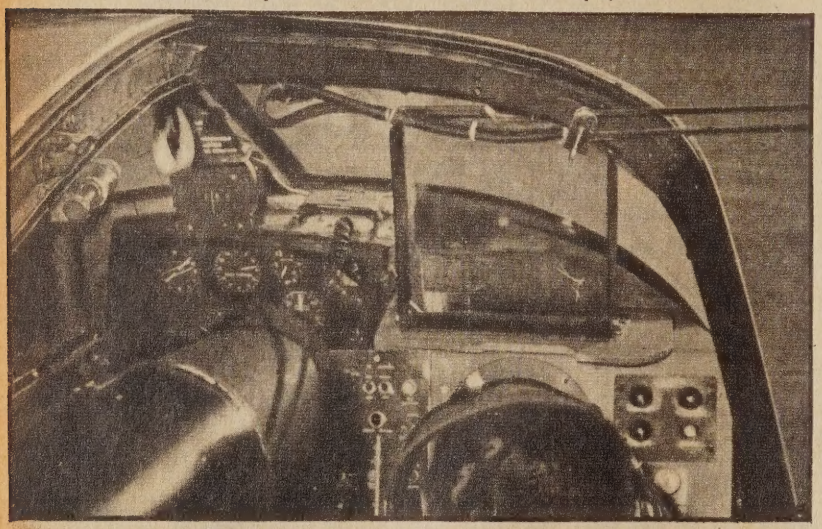
EYES PLAY DANGEROUS TRICKS

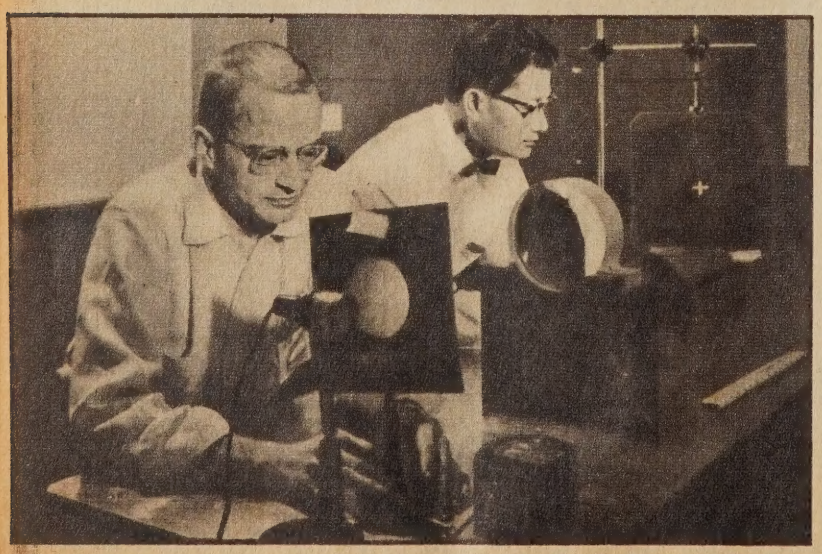
Dr G. B. Byford, at the R.A.F. Institute of Aviation Medicine, Farnborough, has not suddenly taken to posing in fanciful hats. Wearing a contact lens with an illuminated stalk in an optokinetic drum, he is studying such questions as optogiral illusions, suffered when pilots' eyes are rotated rapidly, as in a spin. The same apparatus is used to study optical effects arising from an approach to airfields illuminated only with landing lights.



Any information, such as instrument readings, terrain-avoidance, ground-mapping, which can be shown as a luminous pattern can be optically displayed before the pilot with the new Autonetics equipment.



Pilot's display projector, shown ready for workout under flying conditions, can present any information delivered to it from instrumentation—including horizon line, obstacles.



Critical component is lens system. Here Cliff Thomas and George Dotomto check image of system to determine quality of individual units and accuracy of focal lengths.

Revolutionary . . .

MAN MADE MIRAGE

How does a pilot keep his eyes at the one time on his instruments and on the murk ahead? The answer—he can't! But work now in progress is aimed at presenting vital flight data as a pattern of light on his normal-looking windshield.

By James F. Scheer

A MODEST-LOOKING piece of Autonetics hardware is making a new chapter necessary for physics textbooks.

Appearing to be part of an aircraft windshield, this device, called the pilot's display projector, is an unusual item in two ways — in things it does and in how it does them.

Designed to take blindness out of flying, the pilot's display projector simulates images of the horizon, the outline of obstacles, or the earth below and projects them into the pilot's forward view in proper perspective, as if painted on clouds.

A contact analogue generator, which develops necessary information, feeds input to a cathode ray tube which, in turn, relays an easy-to-see picture to a specially coated reflector.

LUMINOUS GRID

It was not enough for Autonetics engineers and technicians to be able to produce a luminous grid pattern that a pilot could see in fog or dim light only. One of the most challenging problems was in how to make the display visible even in the brightest sunlight.

Under Sr. Research Specialist Paul Mooney, years of study and experiment led to discovery of new principles in psycho-physiological phenomena.

The act of seeing is accomplished by teamwork of body and mind. What the eyes take in is processed by the brain, which interprets this input in producing mental images.

"You see a white house with a green lawn and you remember the pure whiteness of the house," says Mooney. "Then if you take a colour picture of the house, you will note that the white is not pure. It has taken on a green cast from the grass.

"Your brain ignores the cast, because it knows the house is white to the direct view, but it doesn't do so with the photo,

because viewing conditions differ. Your brain, in detecting lack of a certain colour, increases sensitivity to that colour," he says.

Autonetics engineers put into play these interlinking phenomena not covered in physics books. They designed what is called a trichroic combiner — glass coated with multiple layers of dielectric material.

The combiner allows all colours of the visible spectrum to come through but pure green, which is reflected.

One would think that the country or city below would have an unreal appearance when seen through the combiner. Autonetics experts state that this is not so.

The green in nature still comes through and is natural in appearance because nature's green actually is a blue and yellow combination.

ONLY GREEN

Only a pure green is reflected from the combiner. Therefore, when pure green is directed from a cathode ray tube or other luminous sources within the cockpit to the combiner and reflected back to the pilot, its visibility is stepped up.

If a view is seen in which colour is abnormal, the brain detects the lack of intensity or omission of portions of the spectrum and compensates by becoming more sensitive to missing colours.

"What we've done optically can perhaps be illustrated better in terms of sound," says Mooney. "It is like turning up the gain controls on a radio receiving set. What we have accomplished is a means of tricking our eyes to make them extremely sensitive to missing colours."

Optical Coating Laboratory Inc., of Santa Rosa, Calif., worked closely with Autonetics to help translate the psychophysiological concept into a practical optical device. The company made possible the reflection of pure green colour and transmission of other hues by skilful coating of special optical glass in vacuum chambers.

The need for pilot's display projectors was apparent in Autonetics more than five years ago. On North American funds and, later, funds of the Navy, Army, and the Army-Navy Instrumentation Program, the division began studying problems of pilots and optical means for solving them.

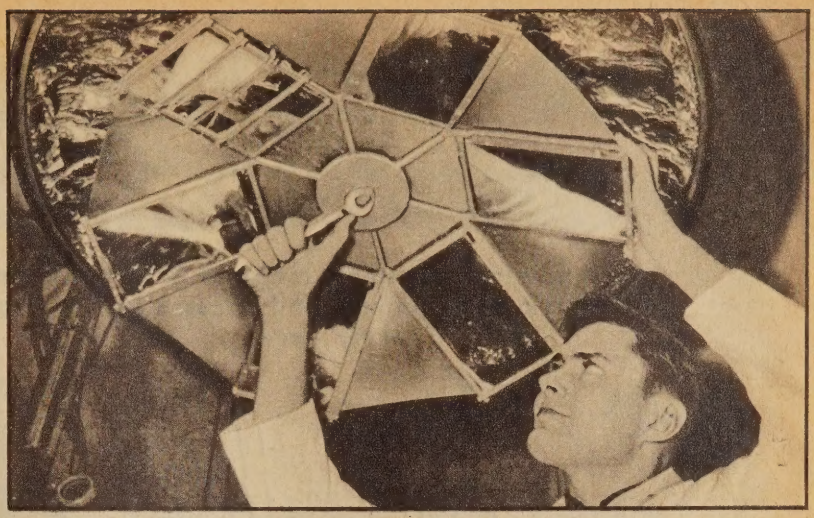
DIFFICULTIES

With the rapid increase in aircraft speeds, pilots were meeting increased difficulties in dividing attention between a panel of dials, gauges, lights, and switches — some 50 to 75 in the modern combat plane — a radar bucket which presents attack-navigation information, and the air-space ahead.

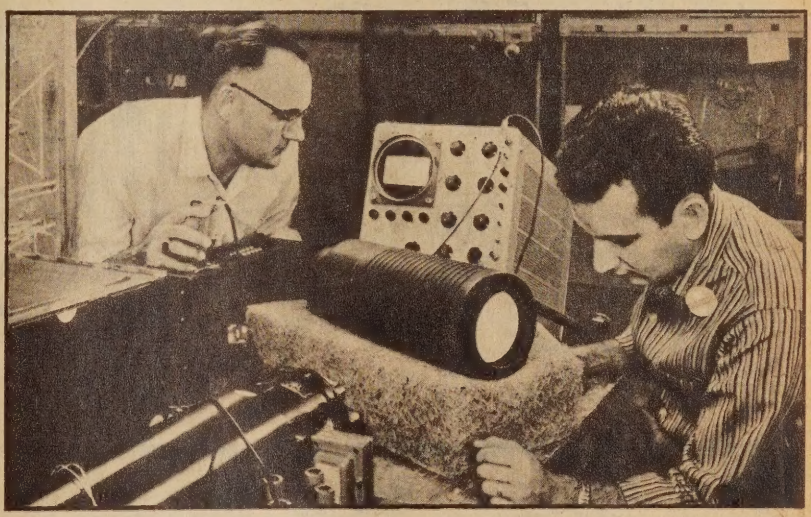
A similar division of attention occurs in the jet transport aircraft with some 300 instruments in cockpit and observer-navigator posts.

Autonetics' solution was to devise an optical system to make possible seeing all necessary flight data — the radar screen and data normally presented by panel instruments in the airspace ahead. This would eliminate the hazards of flight which might occur due to a need for pilots to shift attention from near to far-away objects and vice versa.

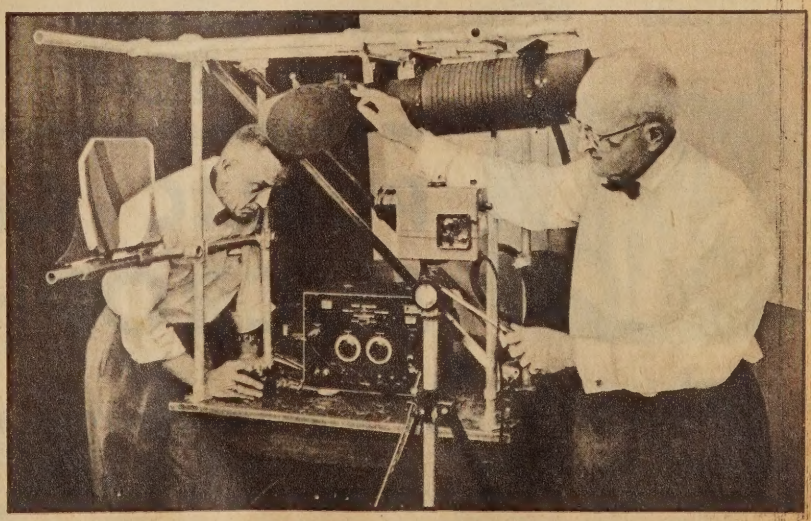
A number of other aids to greater safety are possible for both helicopters



Display projector reflectors are coated at Optical Coating Laboratory, Inc., Santa Rosa, Calif. Here Clyde Fanklin removes the coated reflectors from vacuum chamber.



Roy Jason (left) sets the video level and slope in a synchroniser as he and George Herrington perform functional test of the electronic portion of the display system.



A major problem in design of Autonetics' optical display system was to find a means of making flight information in the pilot's forward view visible against the brightest backgrounds. Mel Burrett (left) and Paul Mooney check degree of brightness against which images are projected.

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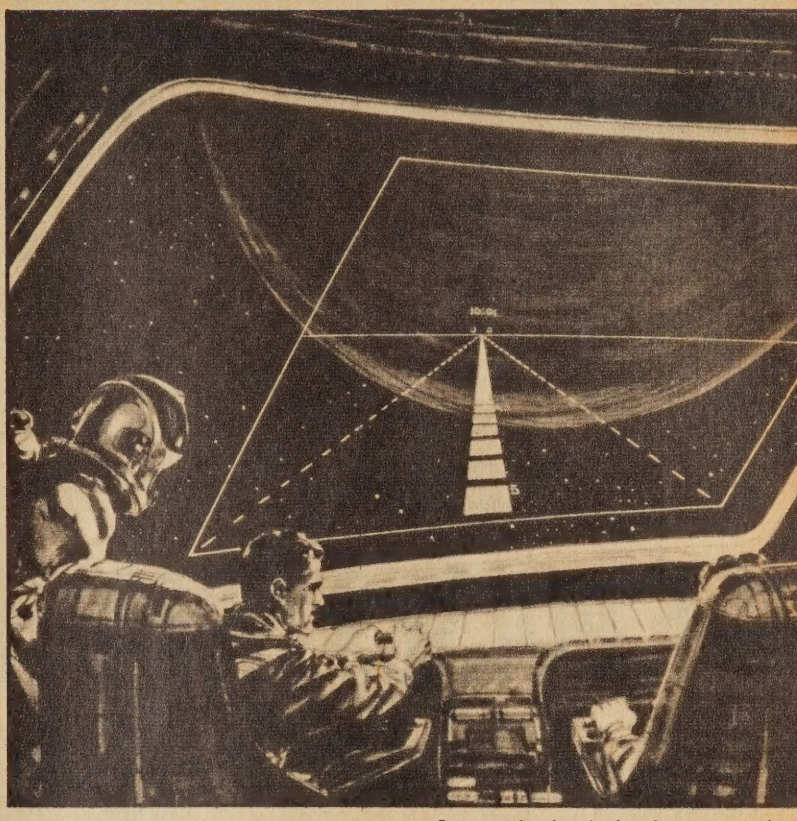


In space travel along the path of the space vehicle, pre-programmed information can be presented as an optical display rather than on instruments, contributing to the simplicity of control to a distant planet.

and fixed-wing aircraft through the pilot's display projector.

These are the terrain-avoidance feature — continuous radar pictures of terrain protruding into the aeroplane's path — the airborne obstacle-avoidance feature, and equipment to make blind landings possible in times of limited or even zero visibility.

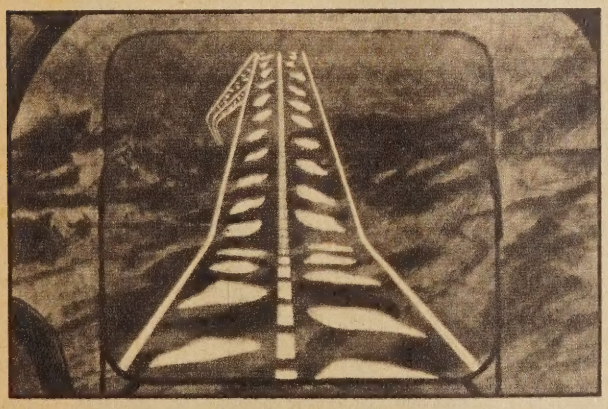
Eliminating the need for the pilot to shift his attention faster than a spectator at a championship ping pong game is an important contribution to safety.

Presenting vital flight control and mission information on the optical display in the man-at-the-stick's forward viewing area is an essential when one considers that jet transports can close on one another at 1,200 miles per hour and Mach 2 military aircraft at speeds above 2,800 m.p.h.

ELIMINATE SMEARING

Collimated images from the pilot's display projector — those presented in the distance — eliminate the smeared images of viewed data under rough flying conditions. They help make low-level, bad weather operations possible.

A radar image may smear due to vibration. Panel instruments may be affected by rough weather or vibration.



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In fair or foul weather the Autonetics pilot's display projector can supply a command path for aircraft to follow, providing highways in the sky when the real world below is obscured as the weather closes in.

☆

The pilot himself may be vibrated in the cockpit. However, with the optical display's image collimated to appear at infinity, no smearing of images takes place.

Optical display projectors show promise for commercial aeroplanes. Today when blind landings under instrument conditions are necessary for commercial aircraft, the pilot strains to watch every movement of instrument gauges while the co-pilot is peering into the fog to catch a first glimpse of the earth.

He thinks he sees the ground and says so. The pilot raises his head from the instruments. If he can't see the ground due to another cloud bank, he doesn't have time to go back to the instruments and tries to establish contact with the ground.

Under such conditions, the pilot and co-pilot may literally have to pray their way down during the last 100ft. With the optical display projector, the pilot can view presented data at the same time he is searching in the forward view for the first possible sight of the runway.

Any data generated by instruments can be presented in the forward view — altitude, attitude, velocity, heading, course, objects to be avoided and other information about the aeroplane.

A future as bright and clear as its luminous pattern is awaiting the optical display. Soon price tags will be low enough for them to be a part of business and private aircraft special equipment. They are already in the "buy" zone for military and commercial fixed-wing aeroplanes and helicopters.

The growing need for them is illustrated by the fact that as many as 40 per cent of all Los Angeles area helicopter flights in a given year have been cancelled due to poor visibility. Most of them could have been completed if the optical display projector had been used.

Interest in the device from an entirel different field was recently shown by a English firm representing Donald Camp bell, son of the late Sir Malcolm Camp bell, famous automobile speed recor annihilator.

Part of the equipment necessary to pe mit driving at about 400 miles per hou is a trichroic reflector presenting a co limated instrument display. Through th English firm, Campbell was in conta with both Autonetics and Optical Coatin Laboratory Inc., which has done exte sive work in devising and applying coa ings for present pilot's display projector

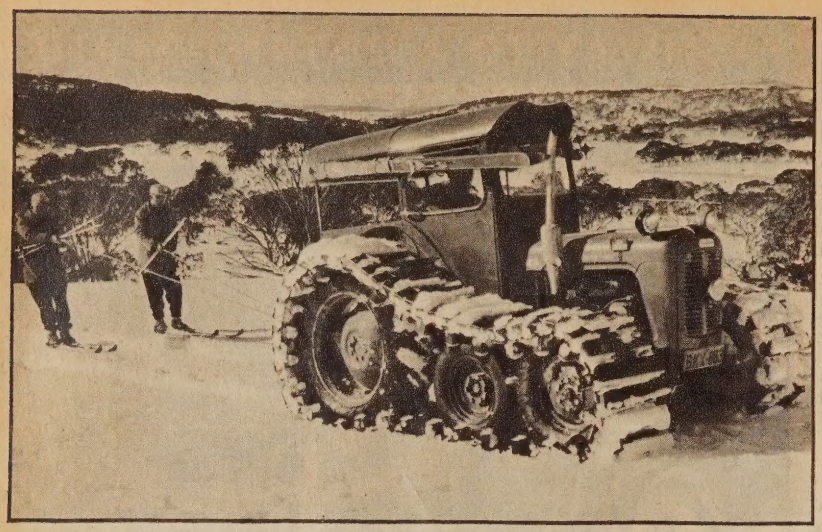
POSSIBILITIES

From a "Buck Rogers" standpoin too, the pilot's display projector has po sibilities. It is not inconceivable tha air lanes will someday be nearly a crowded with vertical take off busines and pleasure aeroplanes as the freeway now are with cars at rush hour.

With no markers in the sky, it ma be necessary to have electronic lane radiating from ground master traffic cor trols. These electronic lane strips coul be painted in the sky on an optical dis play projector while improving th visibility ahead.

Similarly an optical display could hel the traveller to the planets keep track o road signs in space.

A modest-looking piece of Autonetic hardware, the pilot's display projecto — making use of phenomena that neces sitate a new chapter in physics books — is a break-through in appreciation an practical use of little-known human visua capabilities. More important, it repre sents a major break-through in air safety



High-voltage transmission lines in N.S.W. alone would cover, three times over, the distance between Australia and New Zealand. Locating faults in this enormous length of often-inaccessable line poses an enormous problem.

Unfortunately, a number of other hazards, some of them man-made, have emerged.

Two almost unbelievable cases exist of men having climbed steel towers and thrown pieces of wire over the conductors from close quarters.

Aeroplanes have featured in damage to lines, either during forced landings or during low flying, such as when crop dusting. Trailing wires dropped from aircraft towing targets have also fallen across transmission lines.

NATURAL CAUSES

In gales and rain wet branches or long strips of bark have blown off trees and, brushing past conductors, caused flashovers.

There have been a few tragic incidents to young people flying kites or line-controlled model planes.

One of the worst type of faults is caused by irresponsible individuals shooting at insulator strings and breaking a sufficient number to cause a flashover.

Occasionally, under extreme weather conditions ice will form on transmission line conductors, the weight becoming so great, that it causes them to sag and come in contact with each other or nearby objects, or damage the structures to which they are attached.

Ice storms are quite different from snow storms, snow having little effect on transmission lines.

One of the most prevalent single causes of faults of transmission lines is fire. Because of the high electric stress which exists between transmission line conductors, a small amount of flame passing between the conductors will allow the passage of sufficient current for an arc to be formed and cause a short circuit on the line, flame being a conductor of electricity.

In spite of all these things which can affect the flow of power over the line, transmission lines are in general very reliable pieces of equipment.

INCIDENCE OF FAULTS

An approximate figure is that any one hundred mile section of transmission line will probably be involved in one incident, involving damage once each year, but several times each year will suffer transient faults.

All faults are regarded seriously. Even in the case of transient faults the cause is determined whenever possible, as minor damage may have occurred which will later cause a conductor or earth wire to fracture.

In the case of a permanent fault, the urgency of the need to locate the damage and repair it is very great, but unfortu-

H-F PULSES SPOT LINE FAULTS

When a fault occurs somewhere in the many thousands of miles of power transmission line now spanning the countryside, first clue to its whereabouts is likely to be given by an instrument looking very like an ordinary oscilloscope. The instrument may save hours of precious time.

By A. H. GRAY, B.E., A.M.I.E. (Aust.)

TRANSMISSION line faults are generally referred to under two headings.

First, there are "transient" incidents, which cause a momentary short circuit, often called a "flashover," but which do not cause serious damage. The line becomes serviceable again as soon as the electric arc which develops at the fault has been extinguished.

"PERMANENT" FAULTS

The other type are "permanent" faults where the line has suffered physical damage, such as the breaking of a conductor or the shattering of a string of insulators and it remains unserviceable until the fault has been located and repairs effected.

A surprising variety of incidents have over the years been responsible for transmission line faults.

Lightning was a serious menace in the earlier days of transmission networks when the highest transmission voltage was 66 kV.

These older lines generally used conductors of ¼in diameter or less and were carried on wood poles. Further, they frequently consisted of the three power conductors only and did not have strung above these conductors an overhead earth wire.

In the absence of overhead earth wires, lightning may hit one of the power conductors and cause an electrical arc to occur between it and an adjacent conductor.

This arc, supplied with energy by the power stations feeding into the system, continues after the flash and will persist until it burns through the conductors, unless the line is disconnected. Automatic equipment is provided to detect such conditions and open the circuit breakers.

Because of the small size of conductors used on these early lines and the fact that the circuit breakers took a good part of one second before operating, conductors were often burnt through by the arc. This produced a permanent fault instead of the transient fault which is all that should result from a lightning discharge.

POLES SHATTERED

Also, in some cases, heavy lightning discharges would completely shatter the wooden poles on which these lines were carried.

With the introduction of extensive 132 kV transmission, the amounts of power carried by single transmission lines became much larger, and, to obtain improved freedom from interruptions, two overhead earth wires were generally run along the top of these transmission lines.

In addition, conductors were run from the overhead earth wires down the wood poles and attached to earth connections.

With the introduction of steel towers with double overhead earth wires for 132 kV and 330 kV tranmission lines, the effect of lightning on transmission system operation has been still further reduced.

nately location of the damage is sometimes far from easy.

Just imagine a situation: It is nearly dark and beginning to rain.

The line runs across some 80 miles of mixed mountain and grass country. Roads intercept it at infrequent intervals and, to reach many of the towers, involves a trip by a vehicle such as a Landrover, over some miles of rough track and through innumerable gates.

There are about six towers to each mile of line and the damage may have occurred at any point.

Supply is disconnected from several important towns.

DETAILED PLANS

To deal with such a situation, detailed arrangements are worked out and known to all concerned, whereby a maximum number of teams in patrol vehicles will converge on the line, each team having a particular group of towers which they will visit in the search for the fault.

But, even with the best of organisation, it can take many hours to patrol a line and locate a fault by these methods.

Once a fault has been located then the scattered staff must be reassembled and an adequate team go to the place where repairs are needed.

Nowadays, if a fault develops during daylight hours and the weather is fine, it is often possible to fly an expert observer along the line at low altitude to see what has happened.

This method of fault location has achieved some spectacular success, but, even so, some hours could be required to locate the fault, and faults do not by any means always occur in weather when aeroplanes can fly sufficiently low.

It is a strange fact that whereas electrical means for locating faults on underground power cables became very highly developed as long as 40 years ago, little progress was made with apparatus for locating the point of damage on a transmission line until relatively recent years.

Progress in this field resulted primarily from the development during World War II of radar equipment.

A radar set operates by sending out brief bursts of energy in the form of radio waves which travel through the atmosphere until they strike some object.

Part of the energy is then reflected back from this object. At the set a very sensitive receiver receives and amplifies this small returning burst of energy and the set operates by measuring the very small interval of time which elapses between the pulse leaving the set and the echo returning to it.

It was the development of the apparatus to measure with great accuracy these very short time intervals of less than one-thousandth of a second, using cathode ray tubes, which provided the means for developing transmission line fault locators.

In applying these principles to a transmission line, the pulse is applied directly to the line. Such a pulse will travel along the conductors for hundreds of miles without serious loss in amplitude.

The pulse travels at very close to the speed of light; that is, it would travel from one end to the other of a transmision line 186 miles long in one-thousandth of a second.

Upon arriving at the far end of such a line, which would normally be out of service when such a test was made, the pulse would be reflected and would travel at the same speed back to the end from which it was transmitted.

PULSE RETURNS

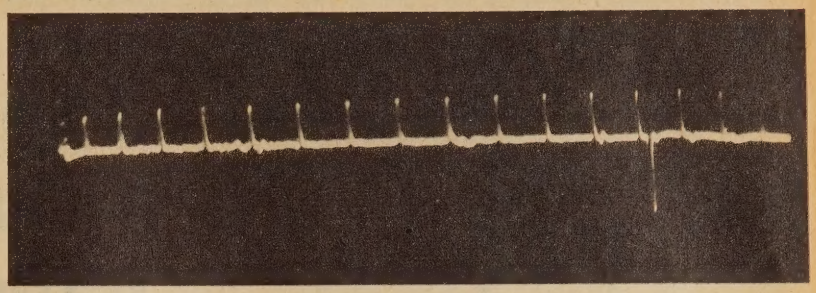
Thus, if a suitable measuring device is connected at the end of the line from which the test is being made, it would be found that the returning pulse arrives there two-one-thousandths of a second after it was transmitted, one-thousandth of a second being required for the trip out and the trip back.

The pulse will travel along the line in this manner provided the conductors of the line remain at the same spacing from each other and are of the same diameter as the conductors of the section into which the pulse was transmitted.

If a conductor is broken, short circuited, or has changed its position, then, according to the degree of the damage, a larger or a smaller amount of the energy in the pulse will be reflected from the point of damage and return to the end from which the pulse was transmitted.

If the point of damage is one-half way along the line, the returning echo will arrive back at the sending end in half the time necessary for the pulse to

TYPICAL LINE-FAULT DISPLAY



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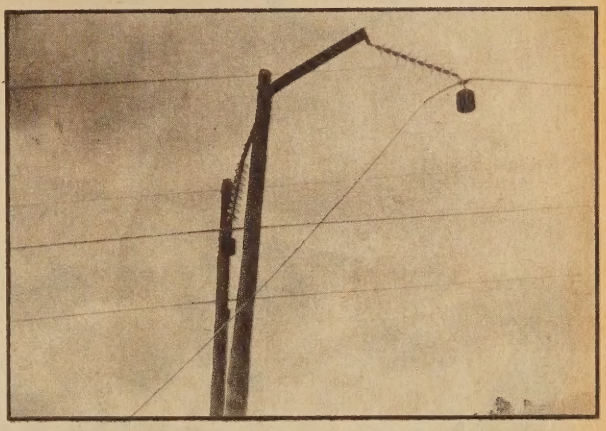
A typical trace displayed on the screen of the instrument. It is on a 132 kV transmission line and shows a short circuit 66 miles distant. Each of the upwards markings represents a 5 mile milepost; the downwards marking is the fault.



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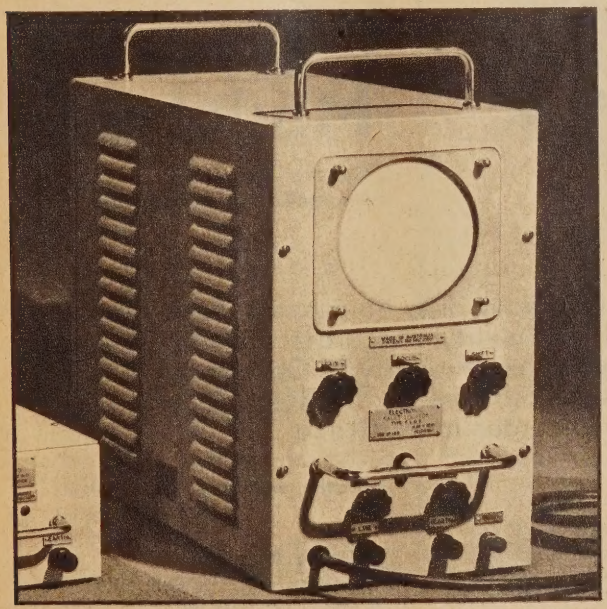

A broken line, as shown above, poses no problem at all. Much more subtle faults show up clearly.

☆

The electronic fault locator — commonly known as "Flossie" — resembles a bench oscilloscope but does a very different job.

☆

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Model 66

General-Purpose Magnetic Tape Recorder

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FIDELITY

- **Frequency Response**

at 3¾ ips 50-6,000 cps ± 3 db
at 7½ ips 40-10,000 cps ± 3 db
at 7½ ips 35-12,000 cps ± 4 db
at 7½ ips 30-14,000 cps ± 6 db

- **Distortion** Less than 1%
- **Flutter and Wow** Better than:
  0.3% at 3¾ ips
  0.25% at 7½ ips
- **Timing Accuracy**
  ±0.1 % (± 1.8 seconds in 30 minutes)
- **Signal-to-Noise Ratio**
  Not less than 40 db unweighted at normal recording level

The Rola Model 66 Recorder is not the cheapest you can buy. It has been built up to a standard, not down to a price, and its performance is not matched by any other tape recorder in its class.

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RT3

travel over the whole length of the line and return.

These are the facts on which the detailed design of such a fault-locating equipment rests.

An equipment using these principles was first developed in Australia in 1946 by the author in collaboration with the engineers at that time responsible for the 66kV and 132 kV systems of the Department of Railways and the Southern Electricity Supply.

It has since found extensive use on most of the major electrical networks in Australia, as well as in a number of other countries.

Other similar equipments have been developed in other parts of the world and locators of this type are now one of the well established methods of locating the point of damage to transmission lines.

TYPICAL EQUIPMENT

One of the illustrations shows a typical picture as seen on the screen of the cathode ray tube when the equipment is in service on a transmission line.

The instrument operates either from 240 volt power point or a 12 v battery supply.

When it is first switched on, a thin pencil line of fluorescent light appears horizontally across the screen and by operation of a switch on the instrument, a series of evenly spaced vertical lines appears projecting upward.

The lines form a ruler type scale of distance, the distance between them representing exactly five miles. These distance markers are generated by electronic equipment within the instrument.

If a lead is now connected to one terminal of the instrument and to one conductor of a three-phase transmission line, which has been disconnected from the system, the straight line on the screen changes to an irregular wave-like pattern, but the distance markers remain clearly visible.

It will be seen that the wavy pattern between each pair of five mile markers is different from that between any of its neighbouring markers.

This pattern is a distinctive one for this particular line conductor, the up and down variations being produced by minor differences in the relative position of the three conductors along the route, by differences in the type of country traversed and by features over which it is erected.

QUICK REFERENCE

Many of these can be identified as known gulleys, crossings of railway lines, river crossings, transpositions, tap offs to substations and the like.

Photographs like the one shown are taken of the patterns on the screen for all transmission lines in an undamaged condition and these are held for quick reference.

When a fault occurs, the instrument is connected to each of the conductors in turn. The pattern obtained on the screen is then compared with the appropriate photograph of the conductor in its unfaulted condition.

A fault will show as distinctive marking and the distance markers enable the operator to read the distance of the fault along the line.

In the event of severe damage, such as a broken conductor or a short circuit, particularly large indications are obtain-

(Continued on Page 143)

FLIGHT PATHS PLOTTED IN 3-D

Chrysler Corporation of Detroit, Michigan, U.S.A., has developed a new plotter which will make three-dimensional graphs of aircraft and missile flight patterns.

COUPLED to radar equipment and to an analogue computer, the 3-D plotter can record and present an almost instant picture of a vehicle's flight path.

At present a great deal of three dimensional data—for example from a missile flight test. is being presented, by necessity, in two-dimensional form. As a result, Chrysler's Robert Felts points out, it is difficult, if not impossible, for the eye to get an image of what is really happening.

One of the new 3-D plotters is to be installed at a still unnamed air terminal for evaluation in approach control, while other early production models are expected to undergo tests at White Sands Missile Test Range.

Among other possible applications for the plotter, some of which are now under study, are weather plotting, satellite tracking, anti-aircraft fire control, anti-submarine warfare, and windtunnel data display. The company itself is interested in using the plotter for programmed machine tool control.

Here's how the device works: A stylus, driven in three axes by three positional servo loops, is suspended in a tank of transparent gel. Signals from an analogue computer to the servo motors move the stylus. Inside the stylus are three ink channels for multi-color tracings. Normally, the ink will be fluorescent to show up better under ultraviolet lighting.

As the stylus moves through the gel, the ink is pressurefed out of the stylus into the gel. The gel closes behind the stylus, like quicksand, trapping the tracings. The ink traces can be kept precisely suspended in the gel as long as desired and then erased with a suction tube, or disappearing ink can be used.

For the future, Chrysler engineers are working on an electronic version of the plotter in which a three-dimensional reading scope will replace the gel, pen and ink.

Scents for Milady

Nor is the mere male averse to the use of perfume. What man would think of putting just plain medicinal paraffin on his hair? No, it must be perfumed. And the perfume must be right. He would not think of putting car sump oil on his hair, despite the statement of his kindly neighbour that it is good for baldness.

The olfactory sense, as our smelling apparatus is called, is a remarkable organ. Not only is it used for smelling but also for blowing, breathing, snorting, running (as in having a cold in the head) and snoring (which is the only occasion it resembles an organ, the musical instrument).

When you buy a bottle of scent, you are not buying a simple liquid but one which may contain as many as fifty ingredients. What is equally surprising, some of the ingredients may, in themselves, be quite unpleasant.

by Calvin Walters

THE art of the perfumer dates back to the earliest times, when man first learnt to mix the oils and extracts he derived from plants and animals.

Today, perfumery is a science and an art, the study of which embraces many branches of science such as chemistry, physics, botany, psychology, aesthetics and so on.

Commodities manufactured by the industry all over the world have a yearly value of many millions of pounds and provide employment for millions of workers in factories and in the field.

It has its impact on seemingly unconnected spheres of operations but which are, nevertheless, as important to the perfumer as any other.

There are hunters in remote places seeking the musk deer, the civet cat and the beaver. These animals provide secretions from glands, which are extensively used in the perfumery industry.

IN WILD FORESTS

There are men in wild forests looking for "tree exudances" such as resins, gums, balsams, oleoresins and other substances which are of value.

Then there are the beachcombers and fishermen who are forever on the lookout for the eagerly sought ambergris, a secretion of the whale.

In laboratories there are chemists mixing and analysing. Others are making vast quantities of alcohol and other solvents.

In glass factories workers are making fancy bottles and jars to add to the appearance of the finished product so that it would appear, in many cases, to be worth the price or even more than it really is.

There are paper manufacturers and printers printing labels for much the same purpose. Artists create new names and designs and, last but not least, there are the "blurb" artists who create all the radio, TV and newspaper and magazine advertising.

Now it has been proved that man is greatly impressed and influenced by delicate perfumes of the right sort worn by ladies of the right sort—and sometimes of the wrong sort—despite his frequent expressions of disinterest.

Such lack of interest is usually professed only on occasions when his own wife wants to purchase some expensive perfume, when he considers Eau de Cologne good enough. He says he doesn't want his wife to smell like a bed of roses or carnations. He only wants her to smell like his wife and that is exactly where psychology comes into the picture.

It has been conclusively proved that perfumes have an individuality. Some perfumes suit a person. Others do not. A lady must choose the right perfume for her personality, no matter what the price. (At this point my male readers will reach for scissors to cut that sentence out before his lady reads it.) The psychological aspect of perfumes is a vast subject which the student is recommended to study.

Why we smell, or to put it beyond misunderstanding, how our noses detect and differentiate between odours is still a baffling problem. There are many theories, none of which have been entirely accepted. This is beyond the scope of this article, however, so we will not enter the discussion further.

Odours can be either pleasant or unpleasant. We can think of many subheadings under the word odour. It wouldn't sound right to say to the girl friend "what a lovely odour you have on." We must say "I love the delicate perfume you are wearing."

VARIOUS MEANINGS

The word smell is usually used when the senses are not favourably impressed, or when one is alluding to an idea or a shady scheme. We say "the whole scheme smells" or it is "on the nose."

If a smell is just faintly unpleasant it is just a smell. If it is very unpleasant, it becomes a stink—perhaps the most expressive word among the various subheadings. This word is also extensively applied to describe very shady schemes or ideas. "These stink." It is also used in a personal sense to describe a bad person. He "stinks," while "I think you stink" is a popular expression used on American TV films.

Then there is the word "effluvium." This is a stylish way (used by the elite) of saying stink. Then we have an "aroma," used mostly to describe the smell of cigars and what we are supposed to smell in whisky and other alcoholic beverages or what comes out of the kitchen stove but does not include the smell of cabbage water.

Then we have a "hum," a word which usually refers to the smell emitted by

a garbage can which has not been "put out" for a fortnight; it is sometimes referred to as being "high."

This word "hum" may have a significance by its connection in a musical sense with the word "organ" referred to previously.

There is a "fragrance" as from flowers, used only in a pleasant sense and "scent" which covers all the pleasant aspects, as well as the substance itself, as in "a bottle of scent."

Finally, there is the word relating to our subject, the "perfume." This engenders in our imagination all that is pleasant and agreeable.

Perfumes have been the cause of the downfall of more men than any other factor, including marriage. History has it that even Cleopatra was not beautiful. It was a special perfume she wore that trapped Mark Antony and Caesar.

COMPLEX MIXTURES

Most of the perfumes sold at the present time are mixtures of a large variety of oils and essences. Eau de Cologne, for instance, may contain up to 26 different substances, such as Bergamot oil, Lemon oil, Orange oil, Rosemary oil, Lime oil, Nerol, Geranium, Musk and so on.

The perfume known as Russian Leather contains 42 different oils and essences. Lily of the Valley contains 37, Chypre contains 45, Lavender Water 45.

Different manufacturers have different ideas about the quantity of various ingredients used and on this depends the varying choices available for perfumes with the same name.

Most of the perfumes available in nature are in the form of oils which are called Essential Oils. These are found in countless varieties of herbs, shrubs, flowers and trees.

The oils are found in different parts of plants. The most valuable are found in the flowers. Others are in the fruit, the roots, the leaves or the bark.

Extraction of essential oils from the plant is a highly skilled process employing countless numbers of workers and chemists.

The purpose of the perfumed oils in plants is a subject still hotly debated. In some plants the purpose seems to be for purposes of reproduction by attracting insects which distribute the pollen and therefore ensure a fertilisation process. Other plants are perfumed for the purposes of protection by repelling the attention of certain insects.

PARTIAL SUCCESS

The chemical composition of essential oils reveals a complicated structure which chemists have been trying to duplicate in the laboratory with only partial success.

Whilst essential oils are a mixture of many different chemical substances it may be that only one of these is the main odour factor.

For instance the chemical methyl salicylate smells exactly like the natural oil of wintergreen. Analysis of the latter reveals that it consists of about 98 percent of methyl salicylate.

In plants which are related to the bitter almond, the active principle of odour is the chemical benzaldehyde, whilst the chemical geraniol is present in many oils, including attar of rose, citronella, palmarosa and quite a few others.

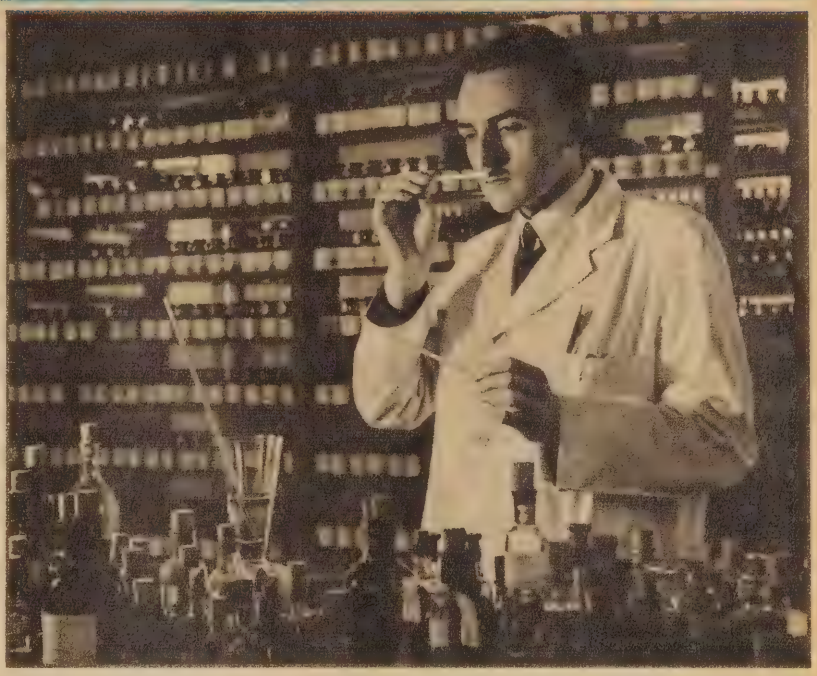
The extraction of natural oils is accomplished in several ways, the most notable being distillation, absorption by cold fats and absorption by hot fats.

Distillation is by boiling the petals or other parts and condensing the volatile oils as they come from the retorts.

In the "cold fat" process, the petals of the flowers are laid by careful hands on plates which have been spread over with fat — mainly lard. Having laid there for about 24 hours, the fat absorbs the oils from the petals and new petals are added.

The strange fact here is that, whilst the petals are attached to the fat, they continue to manufacture the perfume

50 FRENCHMEN CAN'T BE WRONG



Experts claim that not more than fifty men in the whole of France have "the nose"—the ability to detect minute traces of any given essence in a perfume.

A piece of ambergris—one of the most prized ingredients for expensive perfumes. Despite the sign in the background, ambergris comes from the sea. It is not mined.

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Design engineers, keen to utilise the attractive characteristics inherent to Styroseal capacitors have been handicapped to date by capacitance values below 0.022µF.

Now, a range of 46 preferred values affords unrestricted scope in application engineering.

Both the 0.001 to 0.022µF group (200 and 400 VW) and the 100pF to 0.01µF group (600 and 1000 VW), whilst retaining minimum values as previously, now have maxima of 0.56µF

If you are not already familiar with Styroseal characteristics please do not hesitate to contact Ducon Sales Division. Literature is available on request.

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and, by stacking the fat trays in layers, the perfume is not allowed to escape.

After several weeks of replenishing the trays the fat has absorbed as much oil as is possible. The oil is then extracted from the fat by alcohol and from the alcohol by a process of distillation.

The quantity of oil extracted from the petals varies with the flowers being used.

One ton of gardenia petals may produce only one pound of oil. Plants like clove and mimosa produce many times this amount whilst for jasmin, the yield may be only a half pound of oil per ton of petals. Little wonder then that good perfumes are costly and that chemists are forever trying to synthesise them in the laboratory.

The synthesis of perfumes is today quite an extensive industry. Not only are these artificial perfumes used, as such, but they are also used extensively in confectionery and other commodities which require flavouring.

NEW-MOWN HAY

There is a perfume which smells like new-mown hay called coumarin. By reacting salicylic aldehyde with sodium acetate and acetic anhydride, a chemical is obtained which is in every way equal to the natural perfume.

The artificial perfume of heliotrope is made by a synthetic process using a substance named safrole found in camphor and sassafras oil.

There is vanillin, found in ice cream, custards and so on for flavouring and also in the best of perfumes. This replaces the vanilla from the vanilla bean. Vanillin is made from various substances. It can be made from benzene, from coniferon obtained from pine wood, from eugenol found in clove oil and now from lignin, a waste product from wood.

Today, countless perfumes and flavours are manufactured from chemicals in the laboratories of the world and used in the most expensive perfumes it is possible to buy.

It must not be supposed that these artificial perfumes have in any way detracted from the value of the finished perfume. On the contrary, it has been stated that the introduction of synthetics into perfumery has been the greatest contribution to the science since perfumes were first made.

By using synthetics together with natural substances in the blending of perfumes, the perfumery chemist is not only able to make a wider range of exotic and delicate perfumes but is able to greatly enhance the quality of what are recognised as the best perfumes.

OFTEN REPULSIVE

Strangely enough, many of the ingredients of perfumes are not in themselves sweet-smelling. Rather are they repulsive when wrongly used.

For instance there is civet, a substance obtained from the civet cat, found in Asia and Africa. This animal has a scent pouch in both sexes and the horrible secretion is given off when the cat is molested or teased. The scent is powerful and malodorous and one would think quite unsuitable for perfume making.

The cats are kept in captivity and fed on raw meat, which increases the output of the smelly secretion. When ready, the cat is put into a cage in which it cannot turn round. It is now teased whilst the scent pouch is irritated by scratching. At this stage of the proceeding the animal is giving off its most powertul stench (incidentally, I forgot this word among the definitions. It means stink) and the secretion is collected.

In perfumery the civet secretion is used in the most minute quantities as a "fixative," which makes the perfume more endurable and adds what the perfumer calls a "bouquet" to the perfume. It is used in many of the best perfumes.

Then there is a substance called castoreum which is perhaps the most widely used of the animal products.

This substance, which has a most unpleasant and nauseating odour, is taken from the beaver, both male and female. In this case the unfortunate animal must be killed in order to satisfy milady's perfume tastes.

Used in minute quantities, it loses its nauseating odour and imparts a spicy or oriental touch to the finished product.

Castoreum is also very valuable as a fixative. It has been chemically analysed and efforts are being made to make it synthetically.

Most people have heard of ambergris. This substance, a secretion of a sick whale, has been the subject of many adventurous tales and most of us have, at some time or other, hoped to find a lump of the valuable substance on the beach during our summer excursions.

It is, perhaps, the most valuable perfume raw material of all and is eagerly sought by the perfumer.

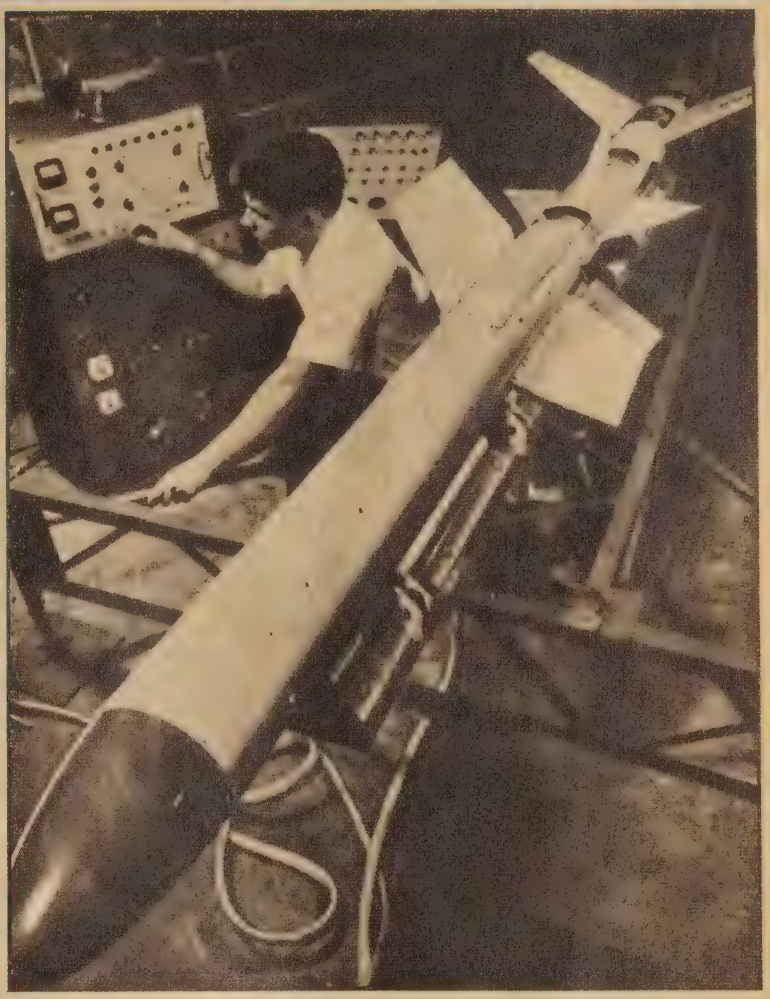
FOUND IN SEA

Ambergris is mostly found in large pieces floating in the sea or washed up on beaches. It improves with age, and the best ambergris is that which has been floating in the sea for a number of years.

Ambergris is a grey, waxy material, with a low melting point. Used in small quantities in the form of an extract, it makes a superb fixative, whilst adding a delicate perfume of its own; enduring and mellowing.

In Asia, there is a small animal called

AMATEUR ROCKET TO BE TESTED



Marshal Kriesel, 20, of Owatonna, U.S., has been planning and building this rocket for five years. Scientists call it "the most sophisticated amateur missile yet." It is the first to be scheduled for a full-scale firing test at the Naval Ordnance Test Range in California.

(Continued on Page 141)

Dual

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1006

1006

FEATURES. Push button operation—stereo key—manual key—built in weight scale and regulator—rumble free 4-pole motor—11in die. Hi-Fi turntable—interchangeable cartridge holder to suit all cartridges with standard fitting—supplied fitted with DUAL CDS 420 cartridge for Stereo and LP records.

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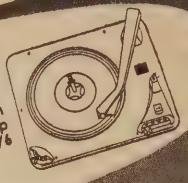
FEATURES. Push button operation, start, stop and repeat—four speeds—tone-arm lock—self stabilising change spindle—outstanding high fidelity reproduction through the DUAL Piezo-electric pickup system CDS 520—Stylus pressure 5/6 gms.



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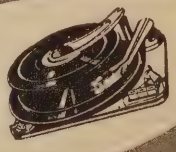
1004S

FEATURES. Push button control, start, stop and repeat—stereo key—pickup arm lock—fitted with Dual stereo cartridge CDS 320—stylus pressure 5/6 gms.



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300

FEATURES: Four speeds—pickup arm lock—turntable brake. Available fitted with CDS 320/3 stereo cartridge or for monaural application the CDS 310/3 cartridge.

WITH STEREO CART., £20/2/-
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NEW METER MEASURES HUMIDITY

Air normally contains water vapour, and many methods have been used to measure the amount present. A new technique having a wide range of possible applications has been developed in the C.S.I.R.O. Division of Physics, one of the three Divisions of the National Standards Laboratory, located in the University Grounds, Sydney.

THE concentration of water vapour in air is usually expressed as the relative humidity. At any particular temperature, there is a limit to the amount of water that can be present in the form of vapour, and air which contains this limiting amount is described as "saturated."

Usually there is insufficient water vapour present to saturate the air. The ratio of the actual amount of water vapour in air to the amount required to saturate it is the relative humidity.

Variations in humidity affect many industrial processes. For example, in all drying operations, the rate of drying depends on the humidity of the air around the material being dried.

The behaviour of textile fibres during processing and of paper during both manufacture and printing are influenced considerably by relative humidity variations.

It is important, therefore, that simple methods of measurement should be available so that the humidity at any position can be determined, and, at any critical situation, can be adjusted to the most satisfactory level.

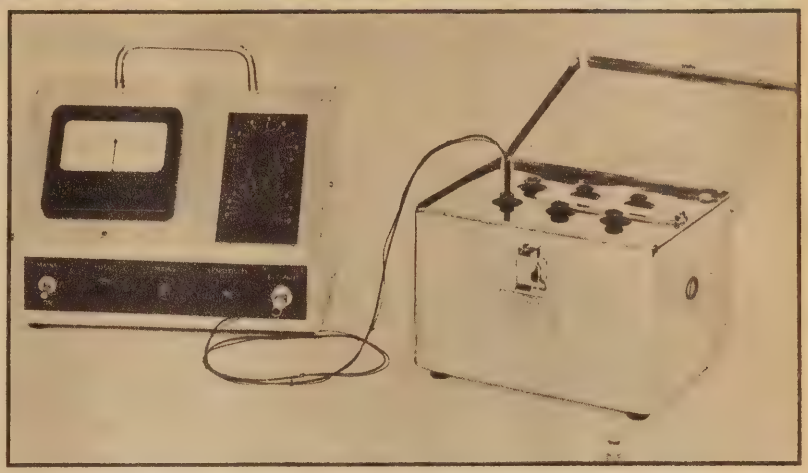
Control of humidity is important, too, in air-conditioning, both for the handling of moisture-sensitive materials and for maintaining the best conditions for comfort and working efficiency.

The new technique, which was developed by Dr R. G. Wylie, depends on the fact that the electrical properties of a coating of oxide on an aluminium surface change with the relative humidity of the surrounding air.

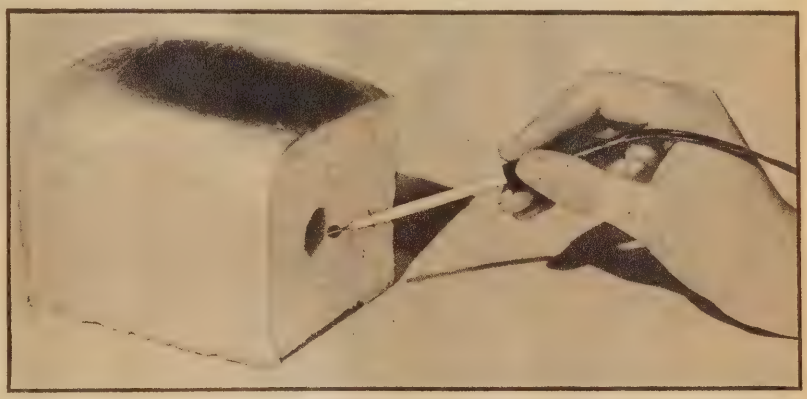
The application of this phenomenon to humidity measurement was suggested by research workers in the United Kingdom several years ago.

The humidity-sensitive elements used in Dr Wylie's technique are made from disks about ¼in in diameter, stamped out from thin chemically-polished aluminium sheet and anodised so that they become coated with aluminium oxide.

The humidity sensitive elements, shown here with a threepence, are disks of thin aluminium about one quarter inch in diameter.



The apparatus consists of a humidity probe, an electronic indicator unit, and a calibrator. The probe is shown in one of the cells of the calibrator.



The small size of the humidity sensitive elements makes it possible to measure relative humidity in localised or confined spaces.

These are placed in a vacuum system and a thin film of gold is deposited on one side, with the exception of a thin strip across the centre. Fine wires are attached to the resulting gold segments to function both as mechanical supports and as electrical connections.

The disk is normally mounted at the end of a glass tube to form a probe, suitable for measurements in highly localised or confined spaces. The electrical leads pass through the tube to an electronic indicator unit.

An important part of the equipment is a portable calibrator. With this the accuracy of the probe can be checked rapidly. It consists of a block of aluminium with six cells, each containing a paste of a suitable substance to maintain the air in the cell at a particular relative humidity.

A probe can be checked at six values of relative humidity in less than 15 minutes. In routine use of the instrument, checking at one or two values is usually adequate.

The equipment can be used to measure relative humidities from zero up to more than 90 per cent. Its ability to perform well at very low humidities is especially valuable, since it has been difficult to make satisfactory measurements in this range.

Over most of its working range, relative humidity can be measured to within 2-3 per cent in about 2 minutes.

The production cost of the elements is low and any damaged in use can be replaced cheaply. This feature, together with the rapid response and reasonable stability of the elements, makes the apparatus particularly suitable for spot-checking of relative humidity.

The elements can also be used for continuous measurement and control of humidity in air-conditioning systems and other installations where the variation of relative humidity is not large.

Arrangements are now being made for the commercial manufacture of the apparatus by a Sydney firm. There is already a considerable demand for the sensitive elements for experimental purposes. These will be produced first, with the electronic indicator unit and the calibrator following later.

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BROWN BAND
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Length (feet)	Reel Size
600	5" or 5¾"
850	5¾"
1200	7"

211
GREEN BAND
(Acetate)

The only premium-quality high-fidelity tape at the standard price. *"Ferro-sheen* processed" 1½-mil acetate. Meets the highest professional standards and all EIA and NAB specifications. Compatible with existing standard bias settings. Superior frequency response characteristics.

Length (feet)	Reel Size
150	3"
600	5" or 5¾"
1200	7"
2400	10½"

601
LONG PLAY
(Mylar)*

A premium-quality *ferro-sheen* process tape with 50% more playing time than standard tape on any given reel size. Made on 1-mil Mylar* polyester film base for longer storage life plus outstanding strength and tear resistance. Meets highest professional recording standards. Superior frequency response characteristics.

Length (feet)	Reel Size
225	3"
900	5" or 5¾"
1800	7"
3600	10½"

Distributed in Australia by R. W. STEANE LIMITED and available wherever quality recording tape is sold.

SORTS CHEQUES AUTOMATICALLY

The first demonstration of automatic cheque handling using E.M.I.'s new Figure Reading Electronic Device—FRED—in conjunction with the Pitney-Bowes/National high-speed document sorter, was given recently at the Hayes headquarters of E.M.I. Electronics Ltd.

A LARGE number of cheques of various sizes from many different cheque printing houses were shown being automatically sorted into their paying branches.

In a typical day's voucher clearing in the United Kingdom, over two million cheques are sorted for return to about 10,000 branches.

CANNOT KEEP PACE

Manual sorting methods are finding it difficult to keep up with the increasing numbers of cheques being used, so the banking industry is studying the advisability of installing electronic figure reading and sorting equipment.

FRED has been developed as a numeral reading machine specifically for use with bank cheques and for other similar business purposes.

All the data normally found on a cheque — such as serial number, branch number, customer's identity and amount —can be coded along the bottom edge using the FRED numerals.

Cheques, in sizes ranging from 6in x 3in to 8in x 4in can be sorted indiscriminately and other special sizes can be handled if required. Punched card cheques, when printed with FRED characters, can be read simultaneously with normal paper cheques.

Accurate spacing of the characters along a line, or the precise positioning of any character relative to the leading edge of a cheque in the sorter is not necessary, and normal printing tolerances are sufficient.

The FRED system makes very few demands on the cheque printing industry, so its adoption would result in keeping cheque printing charges down to a minimum. E.M.I. has carried out extensive tests with hundreds of thousands of cheques from all the leading British cheque printing houses to confirm FRED's practicability.

Some of the data — such as customer's account number and amount — has to be imprinted on the cheques in the banks, so tests have also been carried out in collaboration with the leading manufacturers of imprinting machines.

RELIABILITY VITAL

A reading machine intended for use in business offices should be very reliable, fast, compact and of low cost.

While it is relatively easy to meet these requirements with a bar code reader, since the detection of such a simple "pattern" is a comparatively straightforward problem, it is much more difficult with complex shapes such as conventional Arabic numerals.

This difficulty has been overcome in the FRED system by building a five element bar code into the design of the numerals. The resulting typefaces are visually similar to conventional designs —they are in fact based on an existing fount called Broadway — and are therefore easily recognised by the human eye.

Furthermore, the machine is presented with what amounts to a simple 5-unit bar code, which, with magnetic ink printing, leads to very reliable machine recognition.

The FRED numerals and inter-block symbols are shown in the accompanying diagrams, the corresponding bar code being drawn under each numeral for comparison purposes.

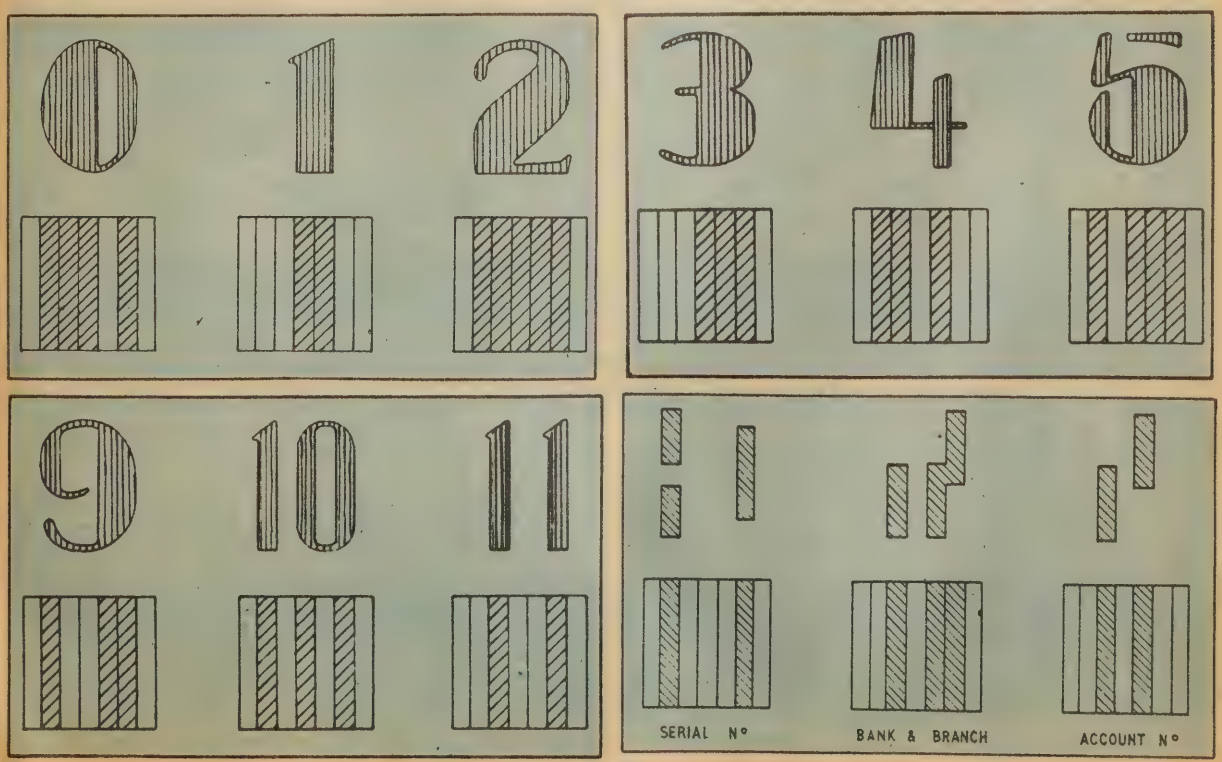
Consider, for example, the numeral "zero." Referring to the bar code beneath this numeral, and reading from right to left the columns are black, white, black, black, black.

If the numeral is also imagined to be divided into 5 equal vertical columns, it is clear that these too (reading in the same direction) are (1) mainly black; (2) mainly white; (3) mainly black; (4) mainly black; (5) mainly black.

EACH NUMERAL CODED

If a "mainly black" column is represented by 1 and a "mainly white" column by 0, the code for zero is 10111, as for the bar code. Each numeral is coded in this way.

As the first digit in each code is always "1"—the right hand column of each character is always black — this form of the code gives four variable digits, with 16 possible combinations.



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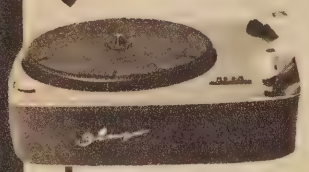
ELAC "BINGO"

4-SPEED STEREOPLAYER *with crystal cartridge*



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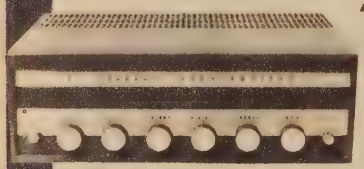

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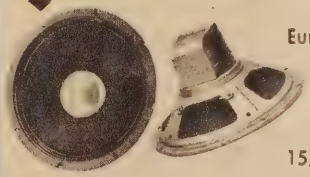

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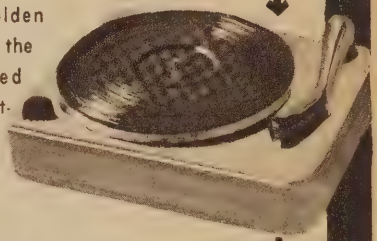

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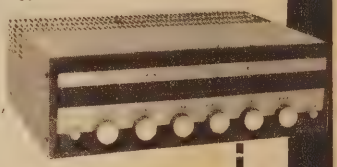

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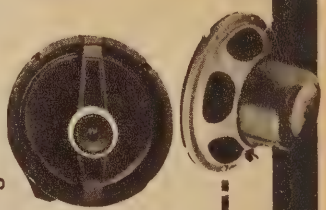

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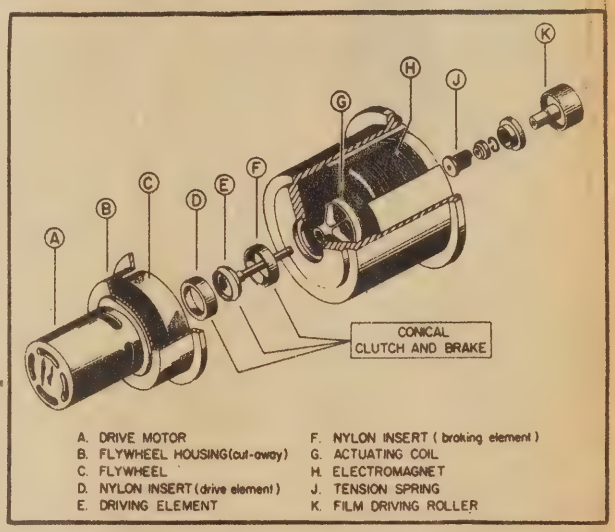
Technical Review

HIGH-SPEED CAMERA RECORDS LIGHTNING PULSES

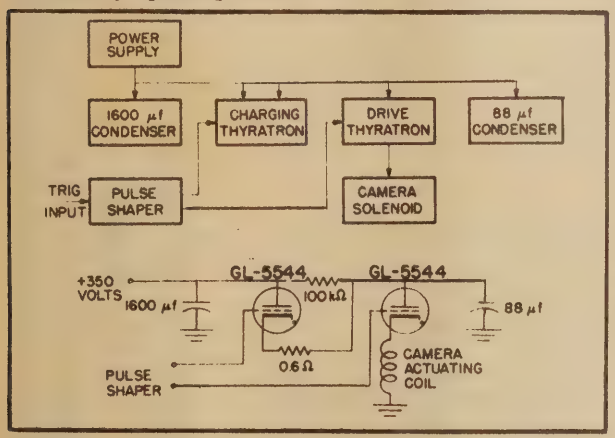
The U.S. National Bureau of Standards has developed a recording system that simultaneously photographs randomly occurring events displayed on an oscilloscope screen and the precise time of each event.

THE camera was developed by G. Hefley, R. H. Doherty, and E. L. Berger, of the Boulder (Colo.) Laboratories as part of a program to record and study the electromagnetic radiation from lightning strokes (sferics) that is propagated over long distances.

Because a picture is taken only when the camera is triggered by the event to be photographed, film consumption is reduced considerably as compared with a continuously operating camera.



Exploded view of high-speed clutch used in intermittent - action camera.



Circuit that controls camera equipment to photograph randomly occurring events displayed on an oscilloscope screen.

When the standard time broadcasts of NBS station WWV are used to synchronise the system, the absolute accuracy is dependent only on the propagation variables of the WWV signal. Cycling time of one complete operation is 7 msec.

Studies of intermittent, randomly occurring events such as sferics require photographic recording instruments of a special type.

Making continuous photographic records of oscilloscope wave-forms is ordinarily the method used to make these records, but it is impractical for long periods of time with strip cameras because of excessive film consumption.

Moreover, the commercially available framing cameras usually do not attain framing rates great enough for certain sferic observations.

Frequently, it is necessary to combine the photographic data with some form of accurate time presentation so that sferics observed at widely separated stations can be identified on a world-time basis and the time interval between sferics can be measured precisely.

The intermittent-action camera provides these advantages.

The rapid framing rate of the camera results from the use of a high-speed clutch between the film drive and a continuously revolving flywheel.

The clutch actuation mechanism is similar to a large electrodynamic speaker. When a pulse triggered by the signal is applied to the clutch part corresponding to the voice coil, a cone is driven into engagement with the flywheel and rotates a small drum in contact with the film.

The length of the pulse is timed so that the rotation of the drum pulls exactly one frame of film past the lens opening.

The peak power applied to the voice coil is approximately 35 kw. Power surges of this magnitude may be repeated at intervals of only a few milliseconds by utilising two condenser reservoirs and two thyratrons in a series arrangement.

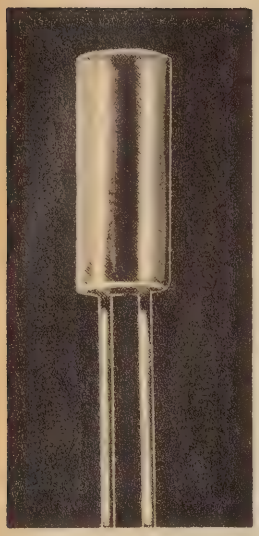
An 88-uf condenser is discharged through the voice coil by one thyratron and after a short delay is recharged from a 1,600-uf reservoir by the other thyratron.

The time of the event is displayed by an array of small neon bulbs that indicate, in binary fashion, numbers that correspond to the hour and date. The bulbs are illuminated by a pulse of 100-usec duration.

The timing circuit consists of conventional decimal-counting units arranged to count from 10 usec to 31 days with the count controlled by a precision 100-kc standard. Each decimal-counting unit has a binary output that is read out by the same pulse used to trigger the camera.

To prevent any ambiguity in the readout, should the binary output happen to be changing state, the time of the readout is controlled by the timer. The readout is made by the first 100-usec pulse following the event to be recorded.

Smaller increments of time are resolved by time markers on an oscilloscope trace separated from the signal display trace.—N.B.S. Technical News Bulletin.



zener diodes

voltage stabilisation down to exceptionally low currents

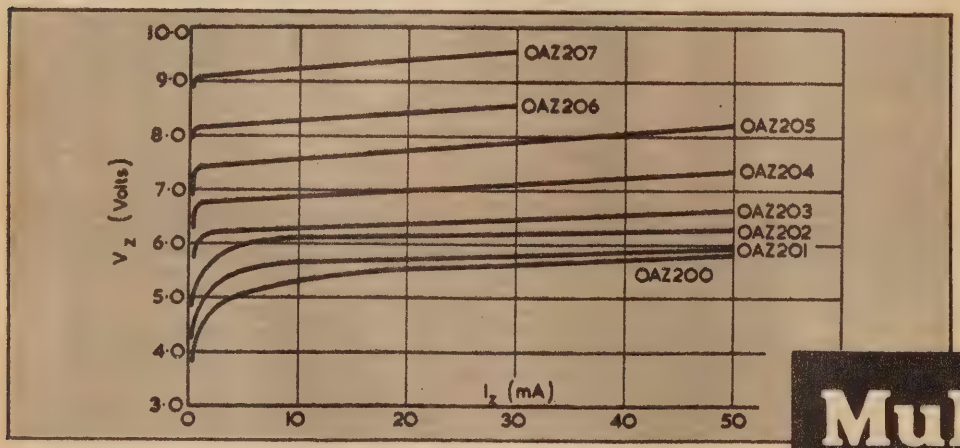
SILICON

Mullard

	VOLTAGE (V)		
5% Tolerance Range	Nominal	Min.	Max.
OAZ200	4.7	4.4	5.0
OAZ201	5.1	4.8	5.4
OAZ202	5.6	5.3	6.0
OAZ203	6.2	5.8	6.6
OAZ204	6.8	6.4	7.2
OAZ205	7.5	7.1	7.9
OAZ206	8.2	7.7	8.7
OAZ207	8.1	8.6	9.6
15% Tolerance Range			
OAZ208	4.2	3.3	5.0
OAZ209	5.1	4.4	6.0
OAZ210	6.2	5.3	7.2
OAZ211	7.5	6.4	8.7
OAZ212	9.1	7.7	10.6
OAZ213	12.2	9.4	15.0

Voltage stabilisation down to exceptionally low currents is provided by Mullard Zener Diodes. This feature is particularly marked in the higher voltage types where stabilisation is provided at currents as low as one milliamp. In all types the dynamic impedance is low and the zener characteristic is very sharp.

Two ranges of these diodes are available One with approximately ±5% tolerance voltages, and the other with approximately ±15% tolerance voltages. In both ranges the change of zener voltage with temperature is only very small, and the operating temperature is from −55 to +150°C.



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WORLD'S MOST POWERFUL TRANSMITTING VALVE

Long-range radar for missile detection and intercontinental television are some of the applications foreseen for this new UHF ceramic-metal valve, which has a maximum usable frequency above 600Mc.

WITH a peak rating of five million watts, RCA's latest super-power tube will be used to explore some of the newest areas in communications. Intercontinental TV is one application where the tube is likely to be applied; scatter transmission for a world-wide communication system is another possible use. At the same time, some of the more conventional uses of RF energy will be affected by the availability of greater power in a smaller package.

Only a little larger than an office typewriter, the A-2346 will deliver 300 Kw of continuous power at frequencies up to 450 Mc and a peak of 5 megawatts in pulse operation. The power dissipation per unit active area of the tube is far higher than normal and is perhaps exceeded only by some high-power transistors.

Maximum usable frequency of the device is above 600 Mc but full-scale tests have not been completed. Although plate efficiency of the tube at 600 Mc is nearly 60 per cent, its power handling ability at this frequency is expected to be less than at 450 Mc.

The new tube was developed at RCA's Lancaster plant for the Air Force and the Rome Air Development Centre, Griffis Air Force Base, Rome, New York.

Specific military applications of the device are still classified but it is known that the tube will be used in high-power, long-range radar.

Since the range of a radar set is proportional to the fourth root of the radiated power, the output stages of the largest radar sets have used the largest available tubes in parallel and push-pull parallel.

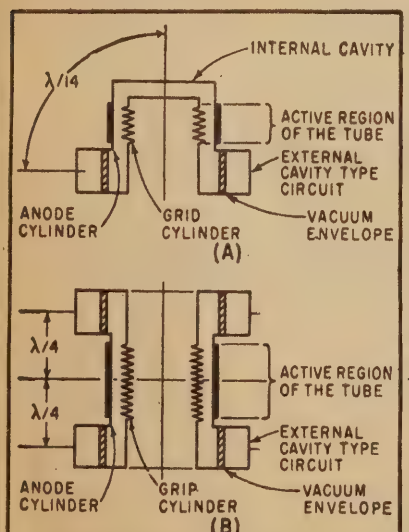
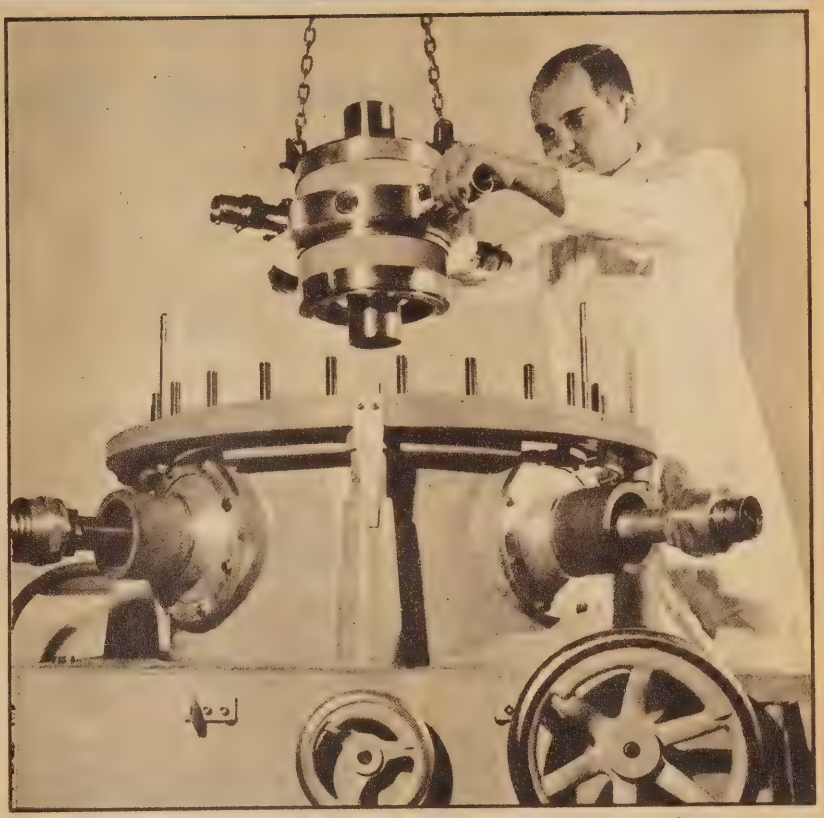


Fig. 1—Single-ended tube geometry (A), has the disadvantage that maximum voltage does not occur across the active region of the tube. Double-ended construction (B), allows both power density and size to be increased.



Gerald Grill guides world's most powerful electron tube into a test chamber at the RCA Electron Tube Division Plant at Lancaster, Pa. The tube, which weighs approximately 150 pounds, can produce 5 million peak watts of long-pulse power at 450 megacycles. It can deliver power enough to explore the possibilities of outer-space communication, inter-continental television, missile guidance, super-power radar, and scatter transmission on a global scale.

There are, of course, many practical problems in paralleling tubes and the practice cannot be extended without limit. The problems are complicated at high frequencies because of inter-circuit capacitance, inductances and voltage ratings.

Some of the other uses for the tube will be in particle accelerators, RF induction heating, and hard-tube pulse modulators.

A design based on adding more and more similar elements in a parallel or repetitive manner is not in itself a bad or an inelegant solution of an engineering problem.

Construction of the A-2346 is based on the same idea of parallel elements, but in this case 96 basic triode elements are combined and integrated into the final tube.

Another important design concept was to consider the tube as a double-ended device. The advantage gained by this approach is that the diameter of the basic structure can be increased without regard to phase relations within the tube itself.

In a single-ended structure, these internal phase relations limit the maximum basic diameter—because of the unavoidable internal cavity formed between grid and plate—and thus the power handling ability. These ideas are illustrated in Fig. 1.

A limitation on the double-ended structure is the possible development of circumferential spurious modes, a limitation that may be lifted when the mechanism of suppression for this type of mode is better understood.

Mechanical details of the structure of the tube are shown in Fig. 2A, which illustrates how the 96 basic triodes are combined and integrated into the final tube. The first step is to combine all the anodes into one copper tube that surrounds the grid-cathode structure.

The grids have also been integrated into one water-cooled structure, with the grid wire wrapped around a precisely machined copper support, at a pitch of 72 turns per inch.

When the grid wire is in place, the grid support structure is subjected to a mechanical rolling operation which mashes the copper groove edges down over the grid spiral. Intimate contact between grid wire and support is thus obtained, and the grid stays at a low temperature.

Also shown in Fig. 2A are the directly-heated, thoriated-tungsten cathodes. Since filament heating current is 7,000 amperes at 4 volts, each of the 96 filament rods carries about 73 amps.

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As the filaments heat up they undergo a certain amount of expansion which cannot be eliminated. The expansion must be taken up, while at the same time the spacing between grid and cathode cannot be allowed to change significantly.

A pantographic member is therefore used as the filament support. The structure shown in Fig. 2B consists of a number of thin chrome-copper leaves in parallel but gold-bonded at both ends. As the spring effect takes up the expansion of the filament, the face of the pantographic structure remains parallel to its original position.

Bowing or arching of the filament is prevented.

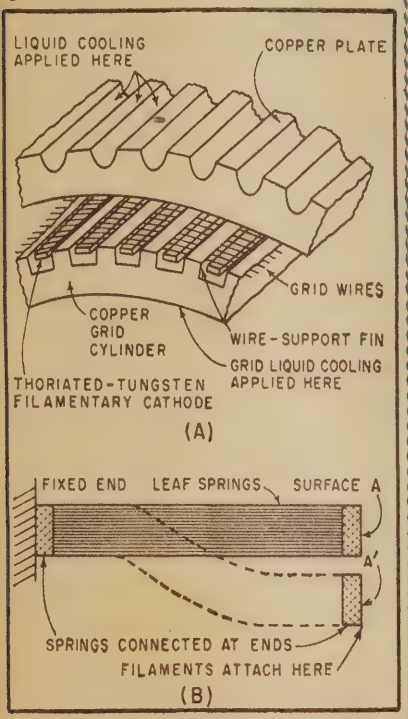

FIG. 2—Basic geometry integrates 96 triodes into one cylindrical structure (A). Pantographic element (B), supports filaments and prevents bowing and arching. Surfaces A and A' are essentially parallel.

In final assembly, ceramic bushings are installed over the active elements. An interference fit between the ceramic bushings and the special tool steel mounting hoops make a vacuum tight seal.

Large power tubes are usually water cooled and the A-2346 is no exception.

Once the tubes have been assembled and degassed, they are tested in a circuit which uses cavity resonators in a grounded grid configuration

Plate voltage of 35 Kv is applied in pulses 10- to 2,000-u/sec wide through a development type switch tube. Peak plate current during the 5-megawatt output test is almost 300 amp.

All high power tubes are subject to occasional internal flashovers. The test set-up includes an overload protection circuit involving an ignitron valve.

Of the test circuit itself, the largest element is the 300 mfd capacitor of the 40-Kv power supply. An entire room is used to house the many individual units that are required to meet the requirements.

(From "Electronics")

AND NOW MICRON-SIZED VALVES!

While RCA engineers are completing work on the world's largest thermionic valve (see previous page) another engineer has put forward suggestions which could lead to "micron-sized" valves. He is Mr Ken Shoulders of the Stanford Research Institute.

ALTHOUGH many aspects of the proposal are, as yet, obscure, it involves marrying of the physics and techniques of valves and transistors to produce tiny valve-like elements encapsulated in a solid block of insulating material.

In presenting a report to the Western Joint Computer Conference in the U.S., Mr Shoulders took a long look into some of the effects found in the world of microelectronics, and re-examined the electronic effects found in conventional vacuum tubes. This unfettered approach was taken in an attempt to attain advances that do not seem possible with present systems.

The approach is based on the examination of electron emission into a tiny vacuum bubble that is encapsulated in a solid block, or in effect, a micron-sized electron tube that can be self-formed in a block of solid material.

Although only a simulated device at this stage, the actual details have been worked out for a new component that seems well suited for microelectronic system requirements and fabrication methods.

This component is based upon the quantum mechanical tunnelling of electrons into a vacuum; has an estimated switching time of 10 to the power minus 10 seconds, seems adaptable to self-forming manufacturing methods giving component uniformity and, what is important, promises immunity to temperature variations between 4K and somewhere within the red heat range.

CHOICE OF DIELECTRICS

Ionising radiation does not affect the cathode properties or other metal electrodes until the dielectric has been severely damaged. The choice of dielectrics for this device is very wide, but materials like aluminium oxide or beryllium oxide, in film form, would be chosen because of their stable characteristics under bombardment.

Mechanical forces would not likely affect this microscopic device either unless a physical crack resulted in the materials.

To help understand this component, called the "tunnel effect vacuum tetrode," the operation of this device may be divided into two parts, namely obtaining electron emission, and using these emitted electrons.

Figure 1 shows one configuration proposed.

Cathode properties have been investigated and there is agreement that the current density can be 10 to the power seven amps per square centimetre with only very small space charge effects.

The current from this source can be varied over seven powers of 10 by a change in field of 2 to 1 at the cathode, implying high gain possibilities.

Tests at 10,000 Mc have verified that there is no detectable deviation from the DC emission characteristics.

The variation of grid voltage would cause the necessary field change at the cathode and measured velocity distribution of 0.14 electron volts shows that this is not a noisy source.

The intention is to form an array of small tips superimposed on the cathode shown in Fig 1. These tips, a few hundred angstrom units in diameter, will provide emission below 100 V when applied to the screen grid or anode. The cathode is normally 3,000 A units wide.

Electron optical considerations dictate how the emitted electrons are to be used. A positive control grid would be used normally, but this would not draw appreciable current because it is located out of the electron path between cathode and anode.

Negative grids are possible if they are smooth or have high enough work function to prevent emission.

It is desirable to collect the electrons at a low plate potential, thus avoiding unnecessary heating. Potentials as low as a few volts seem possible because the field strength would be sufficient to allow the collection of electron current densities of greater than 10,000 amps per square centimetre without adverse space-charge effects.

During this mode of operation, the screen grid would remain at some level near 100-V acting as a bias to help cause field emission, but not collecting an appreciable current.

The fabrication method to make these devices was described in the paper. Vacuum deposition methods were used to obtain starting materials. The fabrication methods provide for vacuum encapsulation with no more difficulties than filling in unused space in a solid-state system. (From "Electronics.")

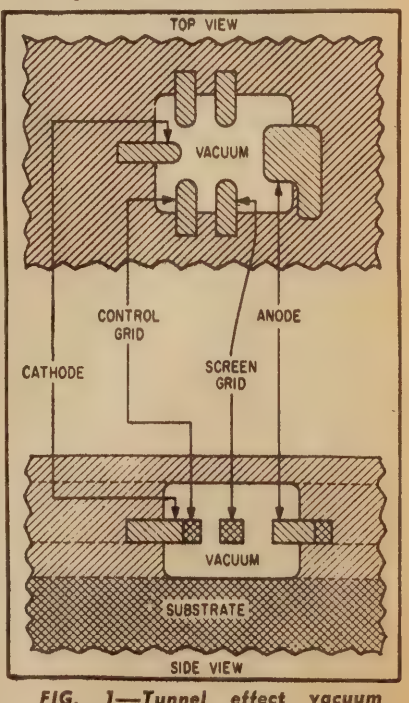

FIG. 1—Tunnel effect vacuum tetrode is intended for use in interconnected arrays having up to 10 to the power 11 components per cu in.

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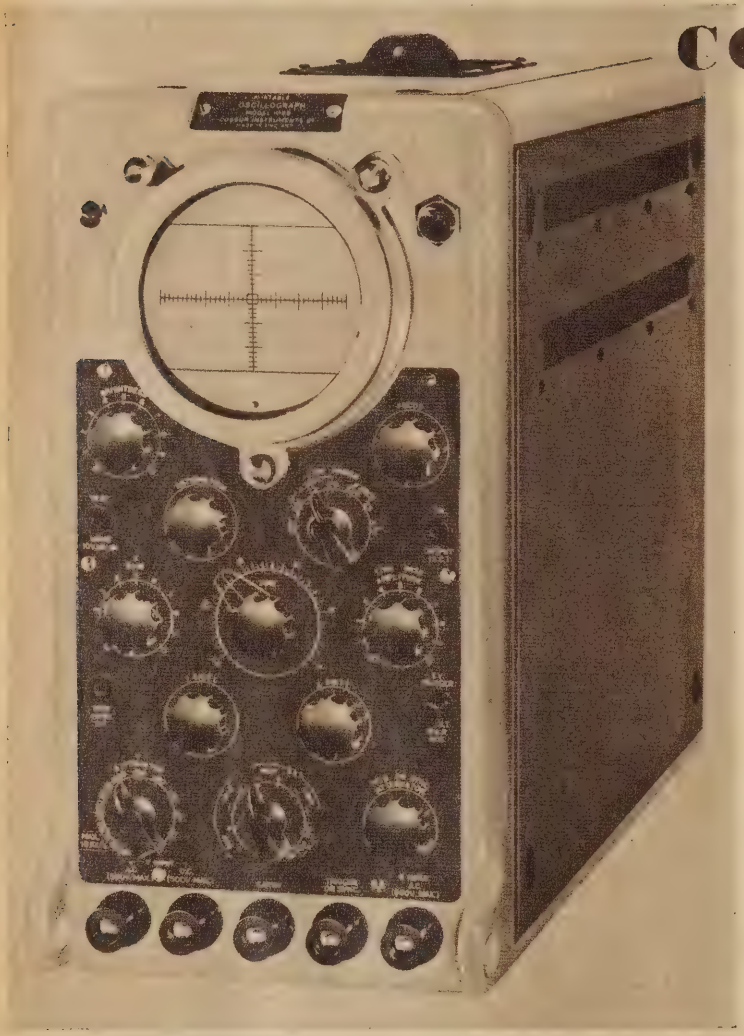

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Single Beam Oscillograph

Designed for television servicing, the model 1058 is fitted with a 4in diameter p.d.a. tube and provides a display of 6 cm amplitude from zero frequency to 6 Mc/s. It has a direct-coupled Y amplifier with a sensitivity of 0.25 V/cm and accurate calibrating facilities and a symmetrical X amplifier. The time-base is free-running or triggered and has a wide range of scanning velocity. Synchronization or trigger is by positive or negative-going pulses (switch-selected) either applied externally or via the Y amplifier. A special facility is provided so that the time-base trigger can be obtained from either frame or line synchronization pulses in a 1 V double-amplitude (positive) television signal. The X amplifier provides a sweep expansion of up to five times. Time calibration is provided and measurements are made directly upon a calibrated scale.

Y AMPLIFIER

D.C. to 4 Mc/s (30 p.c. down) and 6 Mc/s (50 p.c. down).
Separate AC. input terminal giving L.F. response 30 p.c. down at 20 c/s.
Maximum sensitivity 1 cm deflection for not more than 250 mV input.
Rise-time not greater than 90 musec. Overshoot not exceeding 5 p.c.
Input impedance: 1 megohm, 50 pF to 2 megohm, 45 pF
Maximum input: 500 V.
Voltage calibration by 0.5 V plus or minus 3 p.c. D.C. source (at front panel).

TIME-BASE

Triggered or Repetitive.
Five calibrated ranges giving spot velocities from 30 cm/sec. to 1.5 cm/musec approximately.
Ten-position trigger selector giving facilities for operation from Positive or Negative signals from external circuits or Y amplifier and also triggered operation from TV line or Frame pulse on 1 V double-amplitude pulse (positive) composite video waveform.

X AMPLIFIER

20 Kc/s to 200 Kc/s (30 p.c. down) and 500 Kc/s (50 p.c. down) at minimum gain.
20 c/s to 120 Kc/s (30 p.c. down) and 250 Kc/s (50 p.c. down) at maximum gain.
Maximum sensitivity: 500 mV/cm

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SCIENTIFIC & INDUSTRIAL NEWS

SAFER LUMINOUS DIALS

USE of tritium, the radioactive isotope of hydrogen, has been approved for use on clocks and watches instead of radium to make the figures shine at night.

Tritium has none of the gamma rays which make the radium salts for dials a potential hazard. It is normally a gas but can be incorporated in any of several organic substances for application.

TOUGHER TYRES

THE company which developed nylon confirms that it is working on a new tyre cord which has a higher melting point than nylon. They call the new material "HT-1." Reports from outside the company says the new cord's melting point is about 100 degrees above the 400 degrees Fahrenheit of nylon. They also say that experimental tyres have been made.

[Du Pont de Nemours Co., Wilmington 80, Delaware, U.S.A.]

FLUXLESS JOINTS

A NEW process for joining aluminium to stainless steel without the use of a flux has been developed.

The process depends on a special tinning procedure. This is used to tin the aluminium with tin solder containing 1 per cent of silver and 1 per cent of lead. The stainless steel is then likewise tinned with a compound containing 50 per cent of lead and 50 per cent of tin solder. The two tinned surfaces are then sweated together to make a firm and lasting bond.

[U.S. Patent No. 2,937,438. Dated 24/5/1960.]

PUTTING TREES TO SLEEP

A NEW chemical compound is said to regulate the growth of trees in such a fashion that it puts them into a state of temporary dormancy or sleep, thus offering protection from frost.

While they are in this non-growing, or dormant state, fruit trees can withstand far lower temperatures without being damaged in any way than can be tolerated by untreated trees.

Field trials have shown that the fruit production of the trees is unaffected and that the fruit which is produced is of an equally high quality with that of untreated trees, protected by far more elaborate and expensive precautions.

[United States Rubber Co., 1230, Avenue of the Americans, New York, N.Y., U.S.A.]

BETTER PLATE GLASS

PLATE glass said to set new standards in clarity and freedom from distortion is now available for architects and builders in America. The makers claim it is superior to any previous glass when checked in any standard distortion-measuring machine.

The glass is produced in long lengths by drawing the sheet directly from a crucible of molten glass. No mechanical handling device touches it until the sheet has cooled enough to resist distortion.

[Pittsburgh Plate Glass Company, 632, Fort Duquesne Boulevard, Pittsburgh 22, Pennsylvania, U.S.A.]

NEW CERAMICS

A LARGE range of new ceramic compounds fabricated in the form of vacuum tube envelopes, rods, tubes, crucibles, heat sinks, and a wide variety of other shapes, is now available.

The new units are made from pure beryllium oxide ceramics. This material has a melting point of 2,570 degrees Centigrade, a tensile strength of 3,000 lb per square inch and also possesses many other exceptional refractory properties.

As a result it is especially useful for applications where long periods of exposure to very high temperatures are encountered, or where frequent temperature changes occur.

[National Beryllia Corporation, 4501, Dell Avenue, North Bergen, New Jersey, U.S.A.]

ELECTRICAL GLASS

A NEW process for making electrically conductive glass has been developed in Russia.

In the process the glass is heated almost to its melting point and then treated with tin chloride. This process causes the glass to become a permanent conductor of electricity.

Glass treated in this way is said to lose some of its tranparency although only a small amount, and a slight iridescence becomes noticeable, but this extends the use of the glass rather than limits its practical application.

The process is said to be cheaper and in many ways simpler than that used so far for the production of electrically conductive films on the surface of glasses.

It is believed that the electrical properties of the glass are caused by the formation of a thin film of tin oxide anchoring itself to the silica network of the surface of the glass.

[Russian Journal — GLAS-EMAIL-KERAMO-TECHNIK.]

NEW ALLOY

A NEW cobalt-based alloy possesses considerably greater strength and better ductility at high temperatures than previous alloys of the same type currently available.

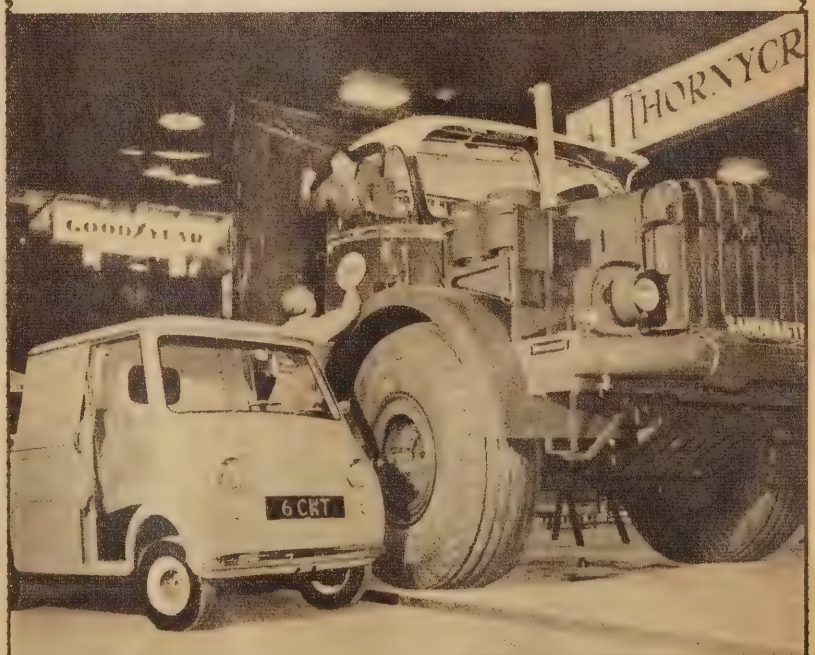
Tests carried out with the new material have shown that at temperatures of 1,800 degrees Fahrenheit, its life before rupture under conditions where it is submitted to continuous forces causing elongation has been increased by 160 per cent over the previous best results achieved.

At the same time stress rupture life is said to have been increased by some 18 per cent.

The new alloy has a very high tungsten content. The increased performance of the material over previously available alloys is said to be due to the use of exceptionally precise refining techniques and the exactness with which the alloying materials are controlled.

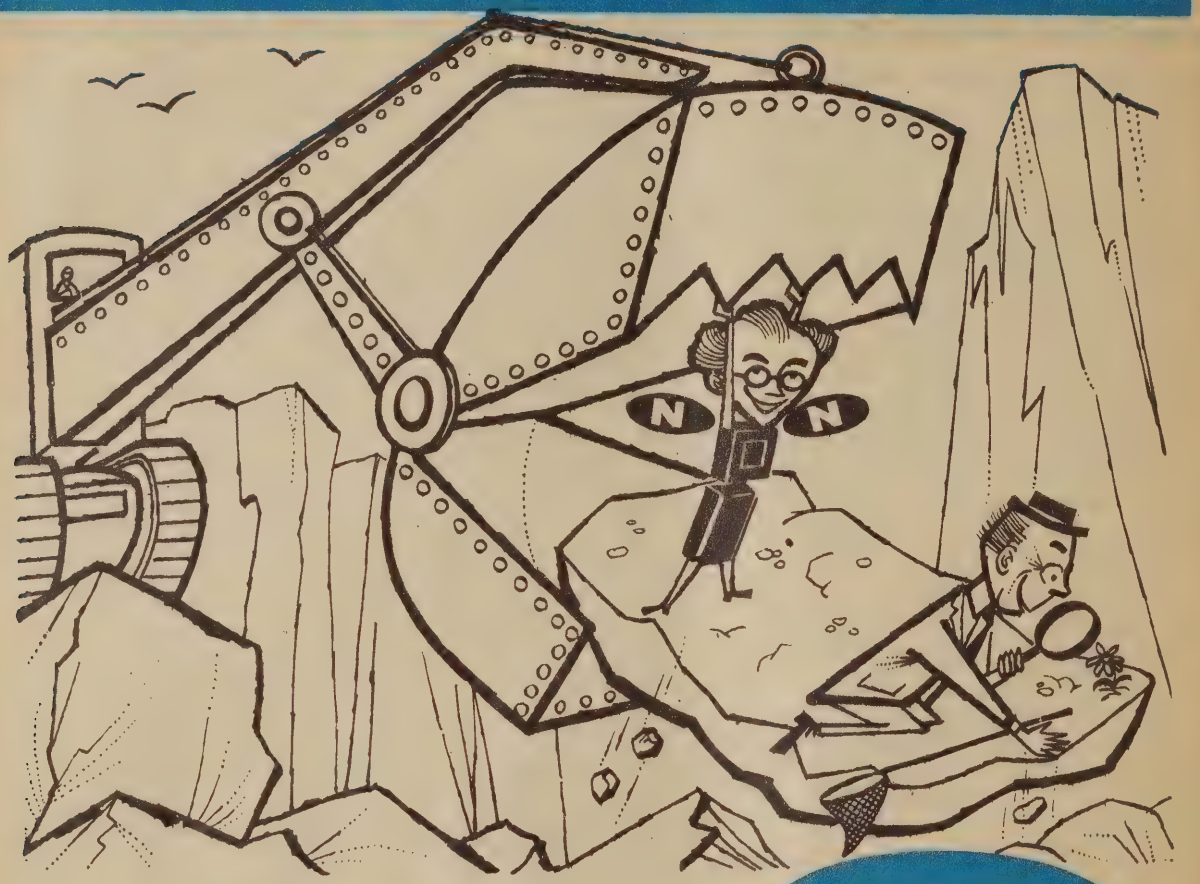
[WaiMet Alloys Co., 5320 Oakman Boulevard, Dearborn, Michigan, U.S.A.]

TRUCKS—WITH A DIFFERENCE



Visitors to the recent motor show in London, saw these extremes in motor trucks. On the left is a Goggomobil 300 c.c. pickup truck. Alongside it is the huge Thorneycroft "Sandmaster," with a 300 H.P. motor.

Service is a National habit!



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msa954D

EASY SPREAD LACQUER

A CREAM that can be spread over bare wood with cheese-cloth to deposit within a few seconds a surface chemically and physically identical to a coat of highest quality lacquer has been developed.

The compound is based on the use of a stable water-based emulsion of cellulose acetate butyrate, similar to that on which the best grades of conventional lacquers are based, and is said to be resistant to both freezing and thawing.

Successive coats of the compound can be applied within a few minutes, due to the fast rate of film formation which virtually eliminates the problem of surface imperfections being caused by the presence of dust in the air. Gentle rubbing of the surface of the film as it forms will fill any irregularities which may be present.

The use of cream eliminates the need for separate fillers, sealers and washcoats, together with such other operations as prolonged drying periods and successive sanding operations, or the use of spraying equipment.

[Eastman Chemical Products Incorporated, Kingsport, Tennessee, U.S.A.]

CLADDING METALS BY EXTRUSION

A METHOD of forming a protection layer or sheath of aluminium on to a steel base has recently been devised. It is achieved by simultaneously extruding the two metals through a single die, the core and the cladding material being contained in two extrusion chambers—one inside the other. Both metals are heated and then forced through the die.

The process is said to be very flexible and to offer many advantages over the more conventional "hot dipping" methods of coating steel. A strong bond can be forced between the two metals and, if desired, close dimensional control is possible. The cladding can be of complex shape, although the design of the base material remains simple.

Another advantage said to be of considerable importance is that besides producing an alloy bond it is also possible to obtain a simple sheathing effect. This points to the possibility of cladding a metal which has been previously coated with a non-metallic material.

[Battelle Memorial Institute, 24 Ryder Street, London, S.W.1, England.]

HIGH-TEMPERATURE STEELS

HIGH temperature melting of steel, followed by high temperature working, promises to give new types of steel three to five times as strong as present ones. The same system applied to more refractory metals may give a product which keeps its strength at 5,000 degrees Fahrenheit, experimental metallurgists say.

Already, steel bars with a strength of 400,000lb per square inch, compared with the previous 300,000lb maximum, have been produced by the new system. It consists of melting well above the normal melting point of steel, followed by "cooling." The metal is worked at this temperature before being cooled to room heat.

Studying the results of the experiments, developers of the new process say there is no apparent reason why million-pound steels cannot be produced for special purposes where the qualities are worth the extra cost.

[American Society for Metals, c/- Union Carbide Corporation, 30E, 42 Street, New York 17, N.Y., U.S.A.]

WOOD WASTE

A NEW technique for processing the waste sulphite "lye" produced as a by-product of the wood processing industry is being developed in Norway.

Preliminary experiments with the new process have shown that this waste sulphite material can be successfully fractionated, or separated, into a series of useful and valuable components, such as sugar materials, calcium salts and other compounds derived from lignin.

Many of these lignin derivatives have important uses in industry, and development work is now being carried out so that a pilot plant trial can be undertaken at a Norwegian cellulose factory.

If, as the experiments indicate, the results are satisfactory production on an industrial scale will be commenced at an initial rate of 10,000 tons of sugar materials and lignin derivatives annually.

Christiania Portland Cementfabrik A/S., Frithjof Nansens pl. 6, Oslo, Norway.

TREADS WITH STRONG GRIPS

A NEW type of metal track for a wheeled vehicle is considerably more efficient in operation on soft ground than spiked or spudded wheels owing to its treading action.

Two advantages of the new type of plate wheel are that it automatically adjusts itself to changing ground conditions whether the surface be smooth or bumpy, while eliminating the need for a pneumatic tyre.

The wheel is also simple to construct and possesses no complex parts to break down, since it does not employ sliding bearings, or gearings. On the other hand, it does make extensive use of rubber to metal bonded construction and, therefore, possesses exceptional elasticity, giving a smoother ride than could otherwise be obtained without the use of a pneumatic tyre.

National Research Development Corporation, 1, Tilney Street, London, W.1., England.

ROT-PROOF COTTON

A NEW chemical process makes cotton fabrics more resistant to rotting and attack by mildew.

The treatment can be applied to all kinds of cotton fabrics. In one test, treated cotton retained 100 per cent of its breaking strength after 21 weeks of exposure in tests using soils containing fabric-destroying bacteria.

Other tests have shown that the process can be used in conjunction with some fabric-colouring pigments to improve the resistance to cotton to deterioration as the result of exposure to sunlight.

The treatment depends upon the use of a colloid of methylolmelamine. This compound forms resin which penetrates the outer portion of the cotton fibre cell wall to become part of the fibre, thus making the treatment far more effective than that which could be achieved by means of a conventional protective coating.

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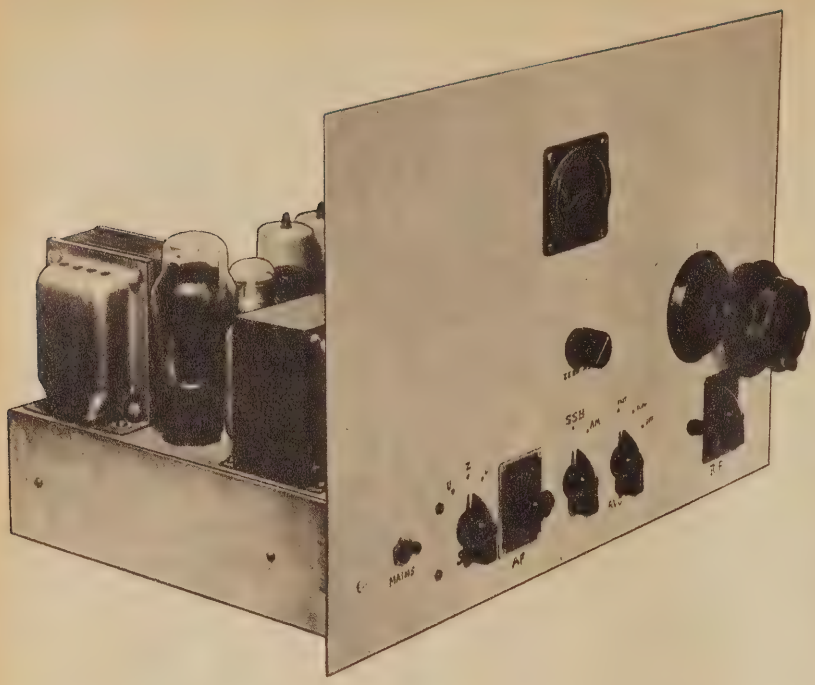


A front view of the receiver built by our two contributors. Note the dial mechanism from the BC-453 at the extreme right.

The Q6er For Single-Sideband Reception

This is the story of a unit built by two Amateur Operators to facilitate reception of single-sideband transmissions. The ideas behind this design should be of interest to other Amateurs, who may be thinking of breaking into SSB.

***By* KEITH JEFFCOAT (VK2BK) & VOL MOLESWORTH, M.A. (VK2VO)**

SINCE the war, there has been a tremendous increase in the number of radio stations operating on the short-wave bands. This is true not only of governmental services and commercial interests, but also of amateur operators.

The result is that the bands have become very congested. So much so, that some delegates to the recent I.T.U. Conference at Geneva even suggested cutting down on the bands specially allocated to amateurs, to make room for other services—a rather drastic and completely negative approach to the problem.

With these crowded conditions prevailing on the air waves—and the position is bound to get worse — the short-wave listener and the amateur alike are finding that they need more highly selective receivers to sort out the signal to which they wish to listen, from all the other signals close by.

Another reason why more selective receivers are needed today is the increasing use by amateurs of single sideband transmission.

The average short-wave receiver, with one or two stages of intermediate frequency amplification at 455 Kc., and beat frequency oscillator injection at the second detector, cannot cope with present band conditions, nor satisfactorily copy single-sideband (SSB) signals.

So far as ordinary AM reception is concerned, the 455 Kc. IF's are too broad in their selectivity to block out completely stations adjacent to the one desired to copy, and BFO injection at the second detector is not sufficient to demodulate satisfactorily a single sideband station, unless the RF gain of the receiver is reduced drastically.

What is needed, to listen in comfort to various short-wave stations, including those using single sideband, is a receiver which has an IF bandpass of about 3 Kc. at 40db down, and some form of detector which can be switched in for SSB reception.

One way to accomplish this would be to rebuild the existing communications receiver, inserting a series of half-lattice crystal filters in the IF line to give the desired bandpass, and adding a product detector to mix the output of the BFO with an incoming SSB signal in the right proportions to satisfactorily demodulate the single-sideband signal.

As against this, crystals suitable for half-lattice filters are rather expensive, and there often is not enough spare room in the communications receiver to accommodate all the extra equipment.

COMMAND RECEIVER?

A better idea is to build a selective IF channel, with provision for switching in a product detector, as a completely independent unit to follow the existing shortwave receiver.

Some readers have made an effort to solve the problem by modifying a special type of radio receiver which was used by the Armed Services during the war.

This receiver, one of the Command series (BC-453) has a tuning range from 190 Kc. to 550 Kc. and an intermediate frequency of 85 Kc.

By feeding some of the IF signal at 455 Kc. from the existing receiver into the Command set, double conversion takes place down to 85 Kc., providing somewhere near the desired bandpass.

However, it is still necessary to add a product detector to copy single sideband satisfactorily, and also to add an additional audio stage and speaker transformer to the Command.

Even if this method were completely satisfactory, it does not provide a general answer to the problem, because the Command BC-453 receivers are very scarce on the disposals market.

In fact, it does not provide a satisfactory answer. A suitably modified BC-453 was put through its paces with the aid of a sweep generator and it was found that the desired bandpass of 3 Kc. from zero to minus 40 db could not be obtained.

Looking around the radio trade houses, it was found that at least two manufacturers produce 85 Kc. IF transformers at a reasonable price. It was decided, therefore, to construct a unit using six of these in pairs, back to back, in order to achieve the desired bandpass characteristic.

Because it undoubtedly improves

selectivity, the BC-453 is popularly known as a "Q5er." When the unit to be described this month was on the drawing board, someone jokingly referred to it, because it went one better, as a "Q6er." The name has stuck, and it is as a "Q6er" that the highly selective IF channel, with sideband copying facility, is presented this month.

The "Q6er" consists of a 12SK7 RF amplifier and a 12K8 mixer. These valves, the tuning gang, and the coils, were all taken from a BC-453 receiver. This portion of the unit could just as easily have used a conventional broadcast 3-gang capacitor and 455 Kc. IF transformers as coils, with equally good results. A 6SK7 and a 6K8, or their miniature equivalents, could be substituted for the valves.

The mixer feeds into two 85 Kc IF transformers, arranged back to back, and coupled with a 15 pf capacitor. The output is fed into a 6BA6 IF amplifier stage, and then into another pair of 85 Kc. IF transformers back to back, once again coupled with a 15 pf capacitor. A second 6BA6, and another pair of 85 Kc. transformers, completes the IF line-up.

The output from the last IF transformer is fed to a diode in the 6AV6 second detector and audio amplifier valve, where demodulation of an ordinary AM signal takes place. To receive single sideband, a 12AU7 twin triode is used in a product detector circuit.

PRODUCT DETECTOR

The grid of the triode section of the 6AV6 is switched, through a volume control, to either the output of the product detector or the diode load, to receive either SSB or AM signals.

The output from the plate of the 6AV6 triode is then fed to a 12A6 audio output valve (taken from the BC-453) and then to a loudspeaker. A 6V6 or 6M5 would have done here.

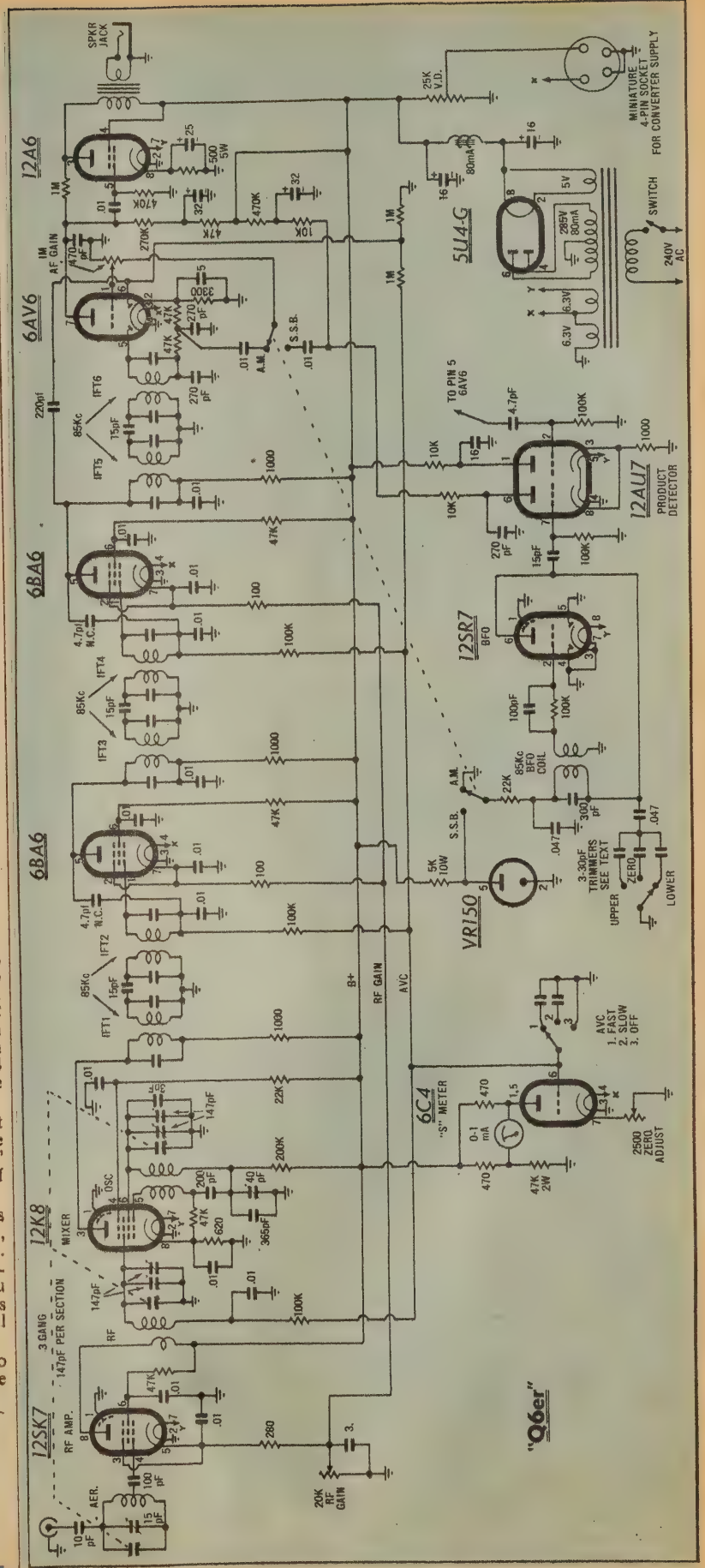
The second diode of the 6AV6 is coupled through a 220 pF capacitor to the plate of the last IF valve, and from this diode is taken the AVC voltage. AVC is applied to the RF stage and to each of the IF stages through 100,000 ohm resistors, and also to the grid of a 6C4 triode which amplifies it to give suitable deflection of an "S" Meter.

A feature of the AVC system is that various values of capacitance can be switched in to provide "slow" or "fast" action, or the AVC can be switched off altogether.

The beat frequency oscillator consists of a 12SR7 valve and an 85 Kc. coil, both taken from the Command receiver. A standard 85 Kc. transformer and another 6C4 would do the job. If you depart from the original layout, it is most important to place the BFO well away from the IF line.

A switch enables the BFO output to be set 1500 cps either side of the centre

The Q6er is normally used in conjunction with an existing receiver which alone has insufficient selectivity for SSB reception. It can be used with a built-in converter, however.



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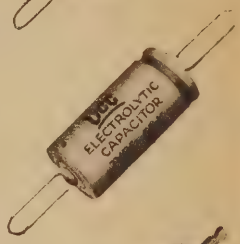

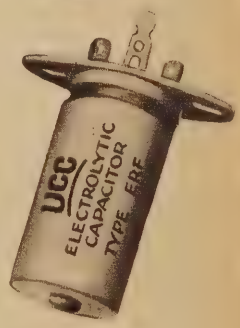

TECHNICAL DATA

CAPACITANCE TOLERANCE:
0 to 100 volts — 10% + 100% 101 volts and over — 10% + 50%

POWER FACTOR:
0 to 100 volts inclusive 30% at 100 cycles per second.
101 volts and over 15% at 100 cycles per second.

WORKING VOLTAGE:
This is the sum of the D.C. voltage and A.C. ripple voltage which can be applied to the capacitor for continuous operation.

PEAK RIPPLE VOLTAGE:
Is the instantaneous value of A.C. voltage across the capacitor caused by the A.C. component. This voltage, as a rule, should not exceed 6% of the rated peak working voltage at 100 cycles per second or 12% of the rated peak working voltage at 50 cycles per second.

PEAK OR SURGE VOLTAGE:
Is the maximum voltage the capacitor will withstand without damage when connected in series with the resistor having a value of $\frac{20,000}{C}$ ohms for 30 seconds: the voltage is measured across the resistor/capacitor combination.

LEAKAGE CURRENT:
All ER and ES type electrolytic capacitors have a finite leakage current. When first connected to a power source the charging current is high, but rapidly drops to a normal value as given by the formula:

$$I = \left(\frac{CV}{10} + 100\right) \mu A.$$

C = Capacity in microfarads.
V = Working voltage.
I = Current in microamperes.

It should be noted that the leakage current given by this formula is the maximum acceptable for satisfactory performance and is normally less than half this value. All readings should be taken at 25°C. after applying the working voltage for five minutes; plus one minute for every month of shelf-storage.

TEMPERATURE:
The effect of temperature is important and it is closely related to and affects all characteristics. The ratings of type ER and ES electrolytic capacitors are based on a maximum temperature of 85°C. The temperature co-efficients of capacity and leakage current are positive whilst that of the power factor is negative.

SHELF-LIFE:
Idle storage has a deteriorating effect on the anode film and should electrolytic capacitors be stored for any length of time they should be re-aged. This is most easily accomplished by applying 90% of the rated voltage to the capacitor in series with a 10,000 ohm heavy duty resistor.

Initially due to a high leakage current the voltage applied to the capacitor will be low, gradually increasing as the current decreases. When the leakage current reaches the rated value the capacitor is ready for use.

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of the intermediate frequency to enable upper or lower sideband signals to be copied.

The cathodes of the RF and IF amplifiers are taken to earth through a 20,000 ohm potentiometer, which serves as the "RF Gain" control.

The "Q6er" was built on a standard 17in x 10in x 3in chassis, with a front panel 18in x 12in overlapping the chassis by half an inch each side and at the bottom.

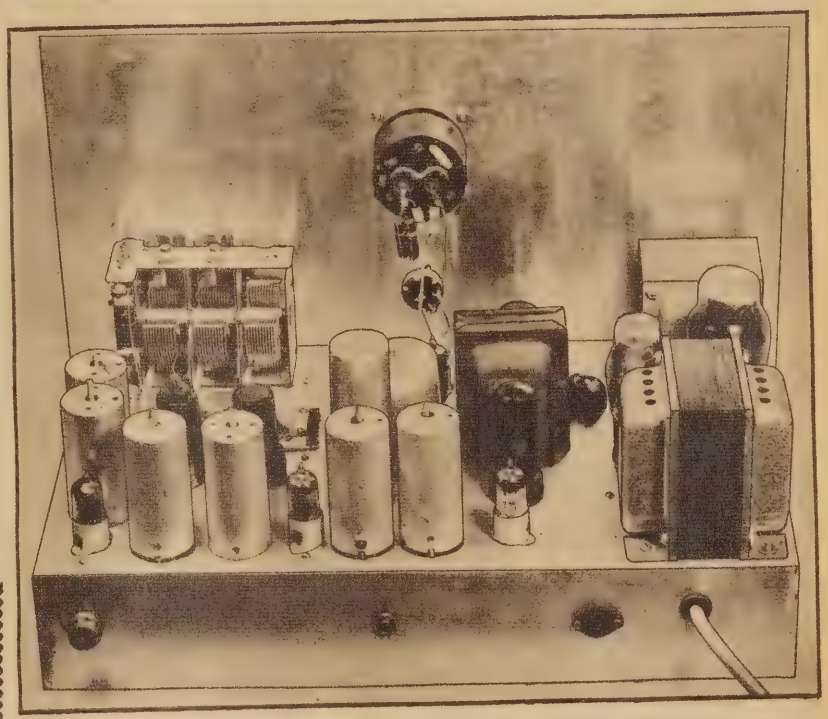
Looking at the front panel, the "S" Meter is seen at the top, with the "Zero Adjust" control immediately below it. This is a 2,500 ohm wirewound potentiometer in the cathode of the 6C4 meter amplifier valve.

Along the bottom of the panel (from left to right) are the Mains ON/OFF switch, Upper Sideband/Zero Beat/Lower Sideband switch, AF Gain, SSB/AM switch, AVC Fast/Slow/Off selector, peaking capacitor for the RF amplifier, and RF Gain. At the righthand side of the panel is the calibrated tuning dial (taken from the BC-453) and a large knob for ease of tuning SSB stations.

It will be seen that the tuning dial is set at 455Kc. This is to enable output to be taken from the communications receiver, which has a 455 Kc. IF. If it is to be used only for this purpose, there is no need to have a calibrated dial or tuning knob. The 3-gang capacitor can simply be tuned to 455 Kc. and the shaft locked into position.

However, in designing the "Q6er," it was thought that a band-switched converter would be added, covering the 3.5 Mc., 7 Mc. and 14 Mc. amateur bands. With a tuning range of 190-550 Kc., it would be possible to cover most of the popular sections of each band. These converters would be crystal-locked so that 190 Kc. would be equal to the lower limit of each band, and the large tuning knob would then be used to tune them.

A REAR VIEW OF THE SSB UNIT



A rear view of the Q6er chassis. Note the pairs of 85Kc IF transformers which give a selectivity curve having very steep sides.

PARTS LIST

The following parts list applies to the unit as described by the contributors of this article. Some of the values are carried over from the BC-453 "front end" and would not necessarily be duplicated if alternative arrangements are made, as mentioned in the text.

1 chassis 17in x 10in x 3in.
1 front panel 18in x 12in.
1 power transformer 285/0/285 volts at 80mA, 5V, 2 x 6.3 V.
1 filter choke 80 mA.
1 speaker transformer to suit output valve.
1 0-1 mA meter.
1 coaxial aerial socket.
1 4-pin miniature socket.
1 speaker jack.
6 octal valve sockets.
1 9-pin miniature valve socket.
4 7-pin miniature valve sockets.
5 pointer knobs.
2 0-10 scales.
1 round knob.
1 large knob.
1 ON/OFF toggle switch.
2 3 x 1 wafer switches.
1 2 x 2 wafer switch.
2 8-lug tagstrip.
1 3-lug tagstrip.

VALVES.

12SK7, 12K8, 2 x 6BA6, 6AV6, 12A6, 6C4, 12SR7, 12AU7, VR150, 5U4.

CAPACITORS.

1 x 3 pf.
3 x 4.7 pf.
1 x 10 pf.
4 x 15 pf.
2 x 100 pf.
1 x 200 pf.
1 x 220 pf.
3 x 270 pf.
1 x 300 pf.
1 x 365 pf.
1 x 470 pf.
15 x .01 mfd 400 V.
2 x .047 mfd 400 V.
1 x 3 mfd.
1 x 5 mfd.
1 x 25 mfd 40 V electrolytic.
3 x 16 mfd 600 V electrolytic.
2 x 32 mfd 525 V electrolytic.
1 x 15 pf trimmer.
3 x 3-30 pf trimmers.
1 x 40 pf trimmer.
4 x 147 pf trimmers.
1 x 3-gang variable.

RESISTORS.

2 x 100 ohm ½-watt.
1 x 280 ohm ½-watt.
2 x 470 ohm ½-watt.
1 x 620 ohm ½-watt.
4 x 1,000 ohm 1-watt.
1 x 3,300 ohm ½-watt.
3 x 10 K ohm ½-watt.
2 x 22 K ohm ½-watt.
7 x 47 K ohm ½-watt.
5 x 100 K ohm ½-watt.
1 x 200 K ohm ½-watt.
1 x 270 K ohm ½-watt.
2 x 470 K ohm ½-watt.
3 x 1 megohm ½-watt.
1 x 500 ohm 5 watt.
1 x 47 K ohm 2 watt.
1 x 5 K 10 watt.
1 x 25,000 ohm voltage divider.
1 x 2,500 ohm pot.
1 x 20 K ohm pot.
1 x 1 megohm pot.

CALIBRATED DIAL

It was thought that a hand-lettered dial would be made and calibrated directly in megacycles for each of these amateur bands.

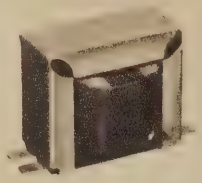
Looking on the chassis from the back, the tuning gang can be seen at left, with the IF channel behind it. The six IF transformer cans can clearly be seen running down the left-hand side and along the back of the chassis, with the 6BA6 valves between them.

At the end of the IF strip is the 6AV6, with the 12A6 behind it. The 12AU7 product detector is obscured by the last pair of IF transformers. At the far right of the chassis is the power supply, comprising the transformer, choke, 5U4 rectifier, and VR150 voltage regulator.

The "S" Meter, which has an 0-1 mA movement, and the Zero Adjust pot, are seen in the middle of the panel.

On the back of the chassis, the coaxial input socket is seen at left, the speaker jack in the centre, and the pow-

FOR THAT *NEW EQUIPMENT*



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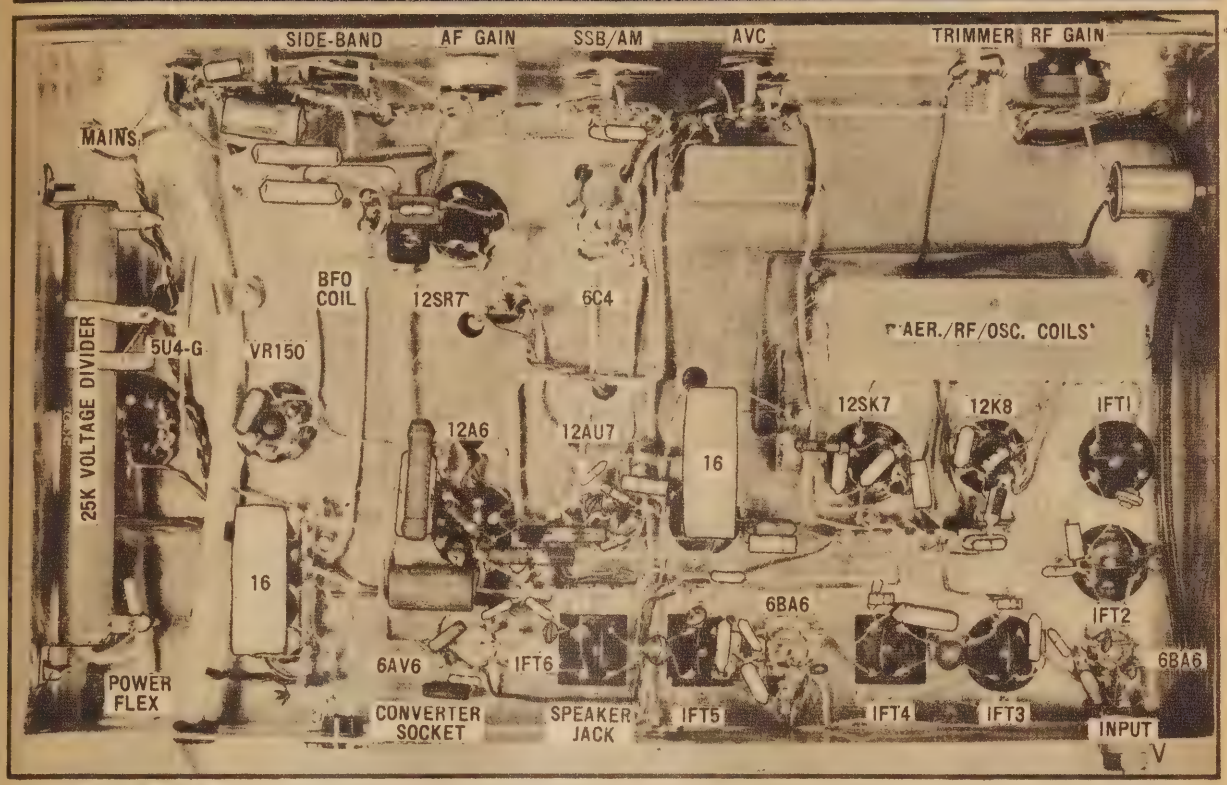
AN UNDERNEATH VIEW OF THE CHASSIS WIRING



The wiring of the Q6er was not arranged, in the first instance, for photographic clarity. However, the above labelled picture indicates the general order of things beneath the chassis.

er cable at right. The miniature 4-pin socket near the power cable provides B-plus, filament volts, and earth, for the converter.

If a converter is built, it can be mounted on the front panel above the tuning gang, in which case the coaxial socket will not be used, the connection being made direct to the stator of the tuning capacitor.

The transformer seen behind the 12A6 is a 7,000 ohm to 600-ohm type. Another transformer, 500-ohm to voice coil, is mounted beside it. This feature is optional, but it allows output to be taken either to line or to the voice coil of a loudspeaker, as desired. The 12SR7 BFO valve is hidden by the first transformer.

Looking beneath the chassis, the power supply section is seen at left. The power transformer provides 285 volts a side, and the output from the 5U4 rectifier is bled through the 25,000 ohm voltage divider seen at the left-hand side of the chassis.

VOLTAGE REGULATOR

The tap about one fifth of the way down is for the VR150 voltage regulator tube supplying only the BFO valve. The first electrolytic capacitor is mounted beneath the top end of the voltage divider.

The second electrolytic in the filter network is mounted on the 8-lug tagstrip running parallel with the power cable, immediately below the VR150 socket.

At the front of the chassis, immediately above the VR150 socket, can be seen the Upper or Lower Sideband selector switch, with three trimmer capacitors mounted across it. Other capacitors lead to the BFO coil can, beside which is the socket for the BFO valve.

The components associated with the IF strip, which occupies most of the rear section of the chassis, are all mounted point to point by their pigtails. A 6-lug and a 3-lug tagstrip help support some of these components.

The 16mfd 600 V. electrolytic capacitor seen in the centre of the chassis is connected to the plate of the signal input half of the 12AU7 (pin 6), to prevent hum in the product detector.

COIL ASSEMBLY

In the top right hand corner can be seen the coil assembly taken from the Command receiver. This consists of three coils—aerial, RF, and oscillator—and some of their associated resistors and capacitors, mounted inside the cans.

This part of the circuit is wired exactly as it was in the Command receiver. We have therefore shown the same values in our circuit diagram.

This coil assembly was earthed in the Command set by its two mounting screws. As assembled in the "Q6er" it is necessary to solder a wire from the coil assembly box to a solder lug on the chassis beside it.

Immediately above the coil box is mounted the aerial trimmer and the RF gain control.

It will be noted that shielded wire has been used to and from the SSB/AM switch and the audio control. It was found absolutely necessary to shield both the filament lead and high tension lead to the BFO valve and the lead coupling the BFO to the product detector.

Apart from these shielded leads, ordinary hook-up wire is used. A little care must be used in wiring up components in the IF strip, since unduly long leads here could cause instability. Careful wiring, and short leads wherever possible, will avoid this.

Having built the unit, the next step is to get it going. The logical way to do this is to begin at the audio end and work backwards to the RF end of the "Q6er." Plug in the rectifier, 12A6 and 6AV6, and allow the set to warm up.

Check that the power supply is working and that high tension (around 290 volts) is present. Touch the grid of the 6AV6 and a healthy "burp" should result in the loudspeaker. Notice that negative feedback is employed by means of a 1-megohm resistor between the plates of the 12A6 and 6AV6. Removing this resistor will increase the output.

Having checked the audio, plug in all the other valves, including the VR150.

NEUTRALISING NECESSARY

As soon as this was done in the prototype, it was found that the IF amplifiers were unstable. To cure this, it was necessary to place a 5 pf capacitor (C.N.) across each IF valve, as shown in the circuit.

Place your finger on the aerial terminal and rotate the tuning knob. You should be able to tune in one of the morse beacon signals transmitted by the shipping and aviation services. The signal "SY," repeated endlessly, is particularly strong in Sydney. Adjust the aerial peaking capacitor for loudest signal.

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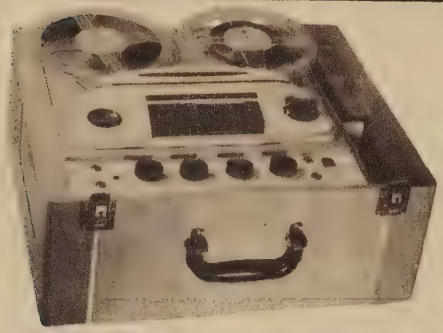

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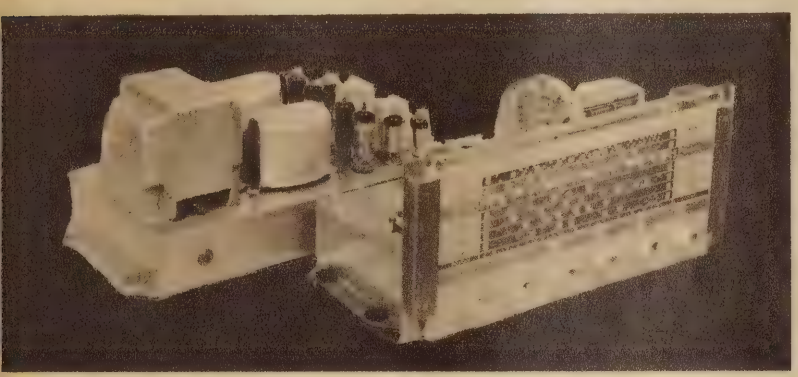

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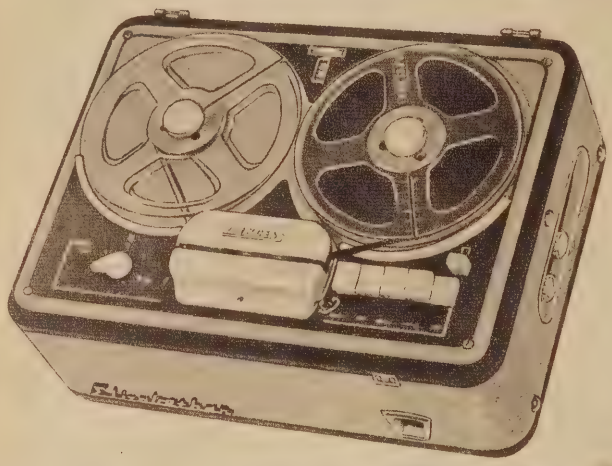

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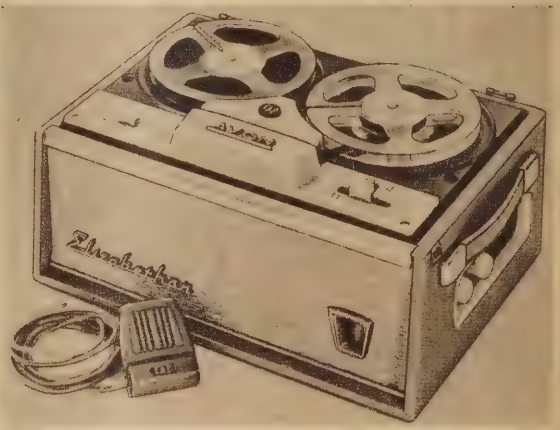

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This establishes that the RF, oscillator and mixer stages are working, and that signals are getting through the IF channel. The next task is to align the IF transformers. The ideal way to do this is to use a sweep and marker generator in conjunction with a cathode-ray oscilloscope, and visually align the IFs for the desired bandpass of 3 Kc.

Failing this, it will be necessary to "load align" the IFs, that is, to damp one winding of each transformer in turn with a suitable load, and tune the opposite winding.

A suitable load can be made by wiring a 10,000 ohm resistor and a .01 mfd capacitor in series. The procedure for load aligning the IFs is as follows:

MODULATED SIGNAL

A modulated signal at 455 Kc. is fed into the aerial terminal from a signal generator, and an AC voltmeter is connected across the secondary of the speaker transformer. Rotate the tuning knob until the highest reading is found on the meter. The dial is now set to read 455 Kc. Now peak the RF and aerial trimmer capacitors for maximum reading on the meter.

The slugs in each of the IF transformers can now be adjusted for maximum indication on the meter to bring them somewhere near to the desired frequency of 85 Kc. Final adjustment of the transformers is made with the aid of the load.

One end of the load is grounded, and to the other end connected to the plate end of the primary winding of the first IF transformer. This effectively damps the primary winding. The secondary winding is now tuned for maximum reading on the meter.

The load is next connected between earth and the grid end of the secondary winding on the same transformer, and the primary side tuned for maximum.

This procedure is repeated with each of the following IF transformers. It may be necessary to switch the AC voltmeter to higher ranges as you proceed, or to reduce the amplitude of the output of the signal generator.

Final adjustment is made by sweeping the generator through 455 Kc. and observing the fall-off in voltage on the meter either side of centre frequency. If two voltage peaks are found, this "double hump" can be cured by making slight adjustment to the transformer slugs.

ADJUSTING "S" METER

Having aligned the IF channel, switch off the signal generator for a moment, and "zero" the "S" Meter. Then switch the generator on again and observe the degree of deflection of the "S" Meter. It may be necessary to wire a small value of fixed resistance across the "S" Meter terminals to reduce its sensitivity.

The "Q6er" is now complete, so far as reception of ordinary AM signals is concerned.

At this stage, a 15 pf capacitor may be soldered to the plate of the mixer valve in your communications receiver and a shielded cable run from the other side of this capacitor to the aerial terminal of the "Q6er."

When a signal carrying speech is tuned in on the communications receiver, it will be heard in the "Q6er." There will be a noticeable tendency towards "bassiness." This is caused by the fact that the "Q6er" has a bandwidth of only 3 Kc., and all audio frequencies above 1500 cps are severely attenuated.

Now for the reception of SSB. By turning the switch on the front panel from AM to SSB, two things happen. We apply high tension to the plate of the BFO valve, and connect the triode grid in the 6AV6 to the product detector.

A product detector is simply a mixer in which the output from the BFO and the incoming RF signal from the IF line are mixed in the correct proportions to provide satisfactory demodulation.

MIXING THE SIGNALS

This is achieved by feeding the output from the BFO into one half of a twin triode and the output from the last IF into the other half. Mixing of the two signals takes place in the common cathode, and the rectified signal is taken from one plate of the valve, the other plate being effectively grounded for RF through a 16 mfd capacitor.

In the prototype, the 85 Kc. BFO coil assembly was removed from the Command receiver, the gear-driven trimmer capacitors across the plate winding removed altogether, and the 364 pf capacitor also across this winding replaced with a 300 pf capacitor. The coil assembly was then mounted beneath the chassis by its original screws.

From the plate end of the coil, a .047 mfd tubular capacitor is connected to the common end of the three trimmers mounted across the Sideband Selector switch.

To establish a reference point for sideband selection, an unmodulated signal is fed into the "Q6er" from the signal generator at 455 Kc., the selector switch is set in the centre position ("Zero") and the 3-30 pf trimmer carefully adjusted for zero beat. It may be necessary to add some small fixed capacitance in parallel with the trimmer to do this.

This will put the output from the BFO

JOINS OUR STAFF

Co-author of this article, Mr Keith Jeffcoat, VK2BK, has joined the technical staff of "Radio, Television and Hobbies." Mr Jeffcoat will spend much of his time developing and describing projects of special interest to Australian amateur operators.

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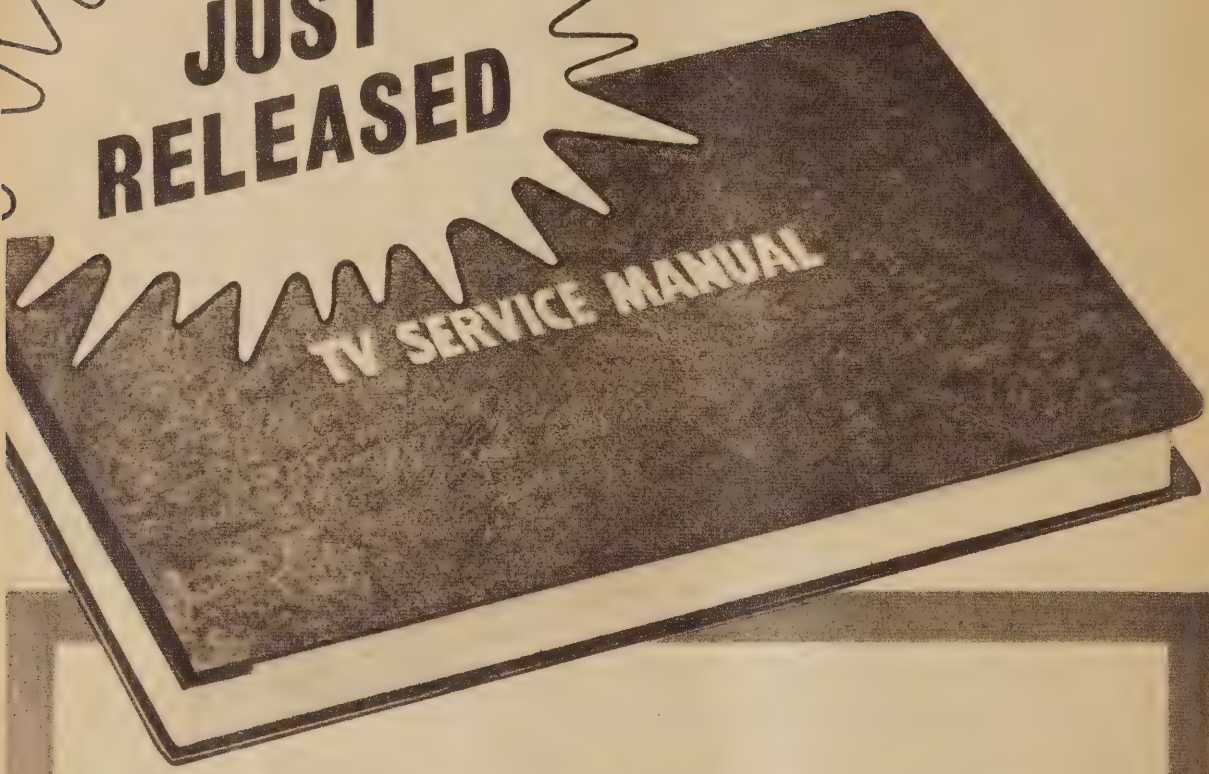

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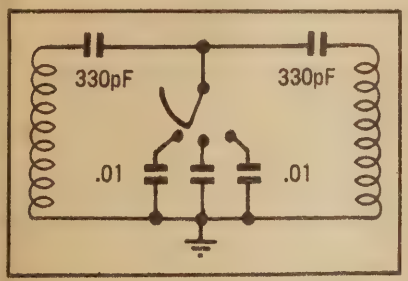
in the centre of the IF bandpass of 3,000 cps. The next task is to adjust the 3-30 trimmers across the other switch positions ("Upper" and "Lower") so that they are, respectively, 1500 cps above and below this reference point.

To do this, switch on your audio oscillator and tune it to 1500 cps. Turn the switch on the "Q6er" to "Upper" and adjust the trimmer capacitor until an audio tone appears in the "Q6er's" speaker which zero beats with the output from the audio oscillator. In this position, there should be LESS capacitance in the trimmer circuit than for the reference point.

Finally, switch to "Lower" and adjust the trimmer for zero beat with the audio oscillator, remembering that it will be necessary now to have MORE capacitance here than for the centre point.

The "Q6er" is now ready to copy a single sideband transmission. Again feeding the output from the communications receiver into the "Q6er" at 455 Kc., listen to one of the amateur bands with the "Q6er" switched for AM reception. When an SSB station is heard, with its typical "duck talk," tune for the loudest audio.



Here is a circuit which can be used on one or all of the double-coupled IF stages, to give variable selectivity.

Before switching the "Q6er" to SSB reception, remember that sideband transmissions below 9 Mc. are usually Lower Sideband, while those above 9 Mc. are usually Upper Sideband. Set the Sideband Selector switch to the appropriate sideband—upper or lower—and then switch the "Q6er" for SSB reception. Carefully adjust the tuning knob on the communications receiver until the "duck talk" is resolved into intelligible speech.

A good receiver? Certainly it is. But there is a bonus. The "Q6er" can be used to copy ordinary AM stations under what is known as "exalted carrier conditions."

Switch the "Q6er" for SSB reception, and tune in the AM transmission by zero-beating its carrier with the BFO in the "Q6er," making sure that the Sideband Selector switch is turned to either the upper or lower position.

Since an AM transmission has both upper and lower sidebands, it does not matter which position this switch is in. However, should the AM station be suffering from adjacent station interference ("QRM"), the "Q6er" enables you to escape this simply by switching to his other sideband.

After you have become familiar with the operation of the "Q6er," you will find that copying sideband signals is quite easy, and that the amateur bands no longer seem as congested as they formerly appeared.

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TRANSISTORS - HOW THEY OPERATE

This is a further article in the series prepared for their servicemen by the *Delco Radio Division of the General Motors Corporation. It reviews current model transistor radios, and discusses points about their operation of special interest to servicemen.

PART THREE

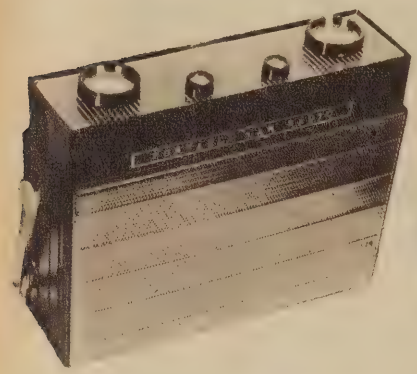


Figure 1: This Australian-made all-transistor portable will double as a car radio, when pushed into a special bracket fastened below the dashboard.

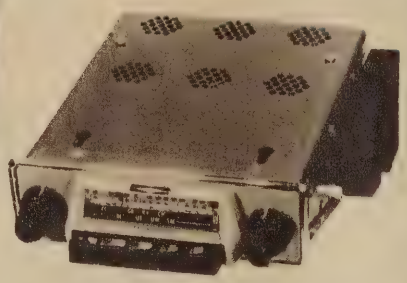


Figure 3: An Australian-made hybrid car radio, using valves in the "front-end" and a power transistor output stage.

TRANSISTORISED radios are encountered in four basic forms, as under:—

(1) Transistor "personal" portables, which are widely used, but not specifically discussed in this article.

(2) "Hybrid" auto radios—a design concept lying between all-tube and all-transistor receivers, and currently very popular.

(3) All-transistor auto radios — the subject of much current research and development.

(4) All-transistor auto-portables, also enjoying current popularity.

Types (2) and (4) warrant further elaboration.

The "HYBRID" AUTO RADIO is one where special low-voltage tubes are used in the "front-end" and a power transistor is used in the output stage. They normally use the 12-volts from the electrical system as both heater and "high tension" supply.

The output transistor draws about 1 ampere (less in some manufacturers' sets because of lower power output) and the tube circuits roughly another ampere, making a total drain on the 12-volt battery of about 2 amperes, instead of the former 3-4 amperes.

Six-volt all-tube radios drew some 5-8 amperes.

It is interesting to note that, with the saving in current and power consumption from the source, these radios have retained their output ratings of up to 4 watts "undistorted" power (i.e., at less than 10 p.c. distortion) and 6 watts maximum.

Thus a considerable increase in efficiency has been gained.

The all-transistor AUTO-RADIO PORTABLE has been developed to allow for alternative use in the car, at the beach, at the sports-ground or in the home.

Such a receiver is outlined in the block schematic of figure 4. The section outlined by the dashed lines is easily removable from the car's glove compartment and provides for something around 100 milliwatts of power output with its 3-inch speaker.

EXTRA STAGES

When plugged into the car unit, an additional RF and power output stage are added to boost the output back up to the 6-watt point.

In earlier models, the manual tuning of the portable was still used when it was plugged into the dash and no push-buttons were available.

In other models, the car unit has its own separate permeability tuner with push-buttons, so that the manual tuner of the portable unit is not used.

In the "break-apart" receivers, isolation of trouble is simplified by the fact that, if the portable does not operate when out of the car, the portable can be reckoned at fault. If the radio is dead only when plugged into the car, then the car unit is normally faulty.

The most common types of transistors used in radios are shown in figure 5. Low power transistors are used in RF oscillator, mixer, converter, IF, detector. and AGC circuits. They are either NPN or PNP polarity types, act as voltage amplifiers and draw very little current, usually .3-1.0 milliampere.

AUDIO TRANSISTORS

Then, working toward the speaker in the radio we must begin to amplify audio, and, therefore, usually find one or more low power audio transistor amplifiers.

These transistors are usually PNP and develop 50-100 milliwatts maximum power, which is sufficient for the output of portable radios, where small speakers are used. They usually draw from .5-10 milliamperes of static current, depending on the circuit design.

The power transistor is usually considered to be a transistor capable of 1 watt or more of power. It has lower internal resistance than other transistors, draws more current and requires a heat sink. It draws 400-1,100 milliamperes, depending on the design and power output rating of the radio.

In Delco receivers, they are usually set at about 1 ampere collector current for 6 watts of maximum power output.

The tube and NPN transistor are similar in many respects, as shown in Figure 6. Both have an element which acts as an electron collector, a controlling

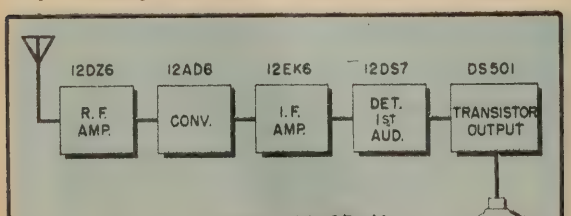


Figure 2: Block schematic diagram of a typical valve-transistor radio, as discussed in the text. It uses four valves and a high power transistor.

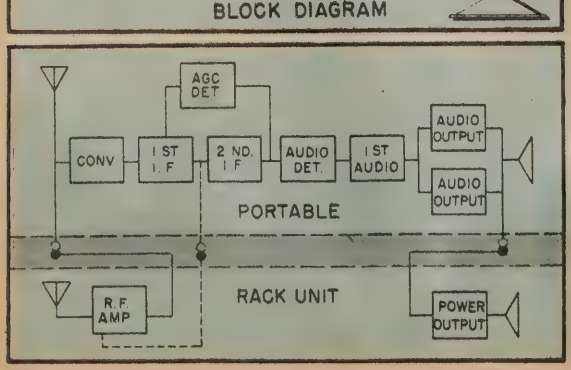


Figure 4: Block diagram of an all-transistor car radio. All but the RF and power output stage can be removed and used as a portable.

☆

* Inquiries re Delco power transistors should be directed to National Automotive Service Co., Box 162 P.O., Dandenong, Vic.

"gate," where the signal is applied and an electron emitter.

The tube, however, has one additional element—a filament or heater which "boils" electrons out of the cathode. The transistor has no filament and must rely on the proper voltage between base and emitter to get electrons started. This voltage is called bias, or forward bias.

Once electrons are started, they follow a similar path to those in the tube. Note, in figure 6, that the tube's electrons flow into the plate circuit, through the battery and back into the tube by way of the cathode circuit. The plate current Ip is, thus, the same as the cathode current.

COLLECTOR CURRENT

In the transistor, the collector current Ic takes a similar path shown by the arrows.

Current flow in a transistor requires forward bias—a word which has sometimes been a little mysterious in tube circuits. Actually, bias simply means influence and, in this case, it is a voltage which influences electron flow within the transistor.

Forward bias means a voltage which will influence the electrons to move forward.

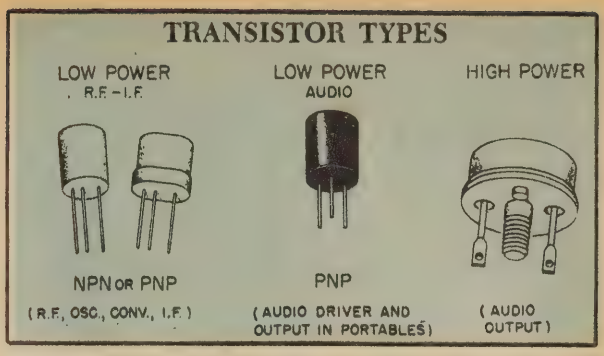


Figure 5: Common transistor types. Most audio transistors are PNP, while RF and IF transistors are either NPN or PNP.

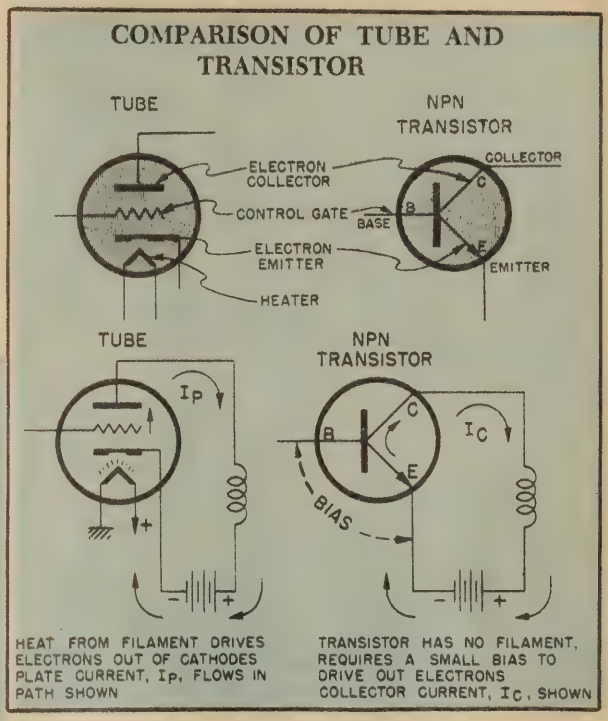
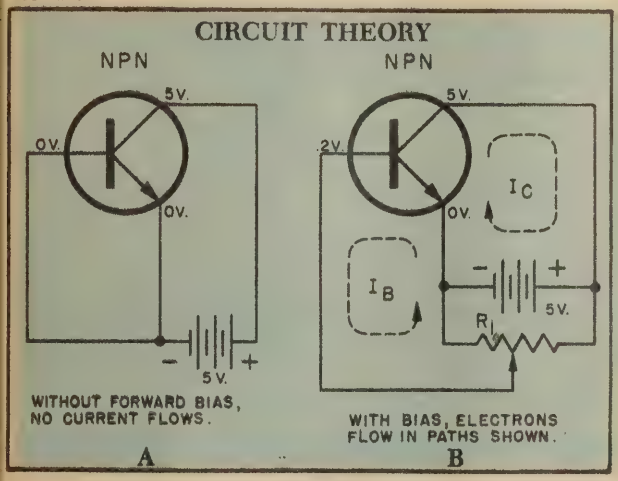


Figure 6 (above): These diagrams indicate the comparison which can be drawn between current flow through a valve and a transistor.

Figure 7 (below): A forward bias applied between base and emitter initiates a very small base curent (IB) and a larger collector current (IC).



Since the transistor has no filament, some electric force must be present between the emitter and its adjacent element, the base, to get electrons started. Otherwise, the transistor will act almost like an open circuit, and practically no current will be able to get through it.

In figure 7A the current in the base circuit Ib is O and the output current in the collector circuit Ic is negligible. Note that the transistor is shown as an NPN type.

However, in figure 7B, a simple system has been added for getting a small positive voltage on the base. This consists of a potentiometer R1, which allows us to tap off any voltage we choose from the main battery source.

The farther right we go on the arm of R1, the larger the base voltage becomes and the larger the base current Ib becomes. However, as the electrons leaving the emitter pass into the base area of the transistor, most of them come into the strong electric field at the collector (5 volts positive) and this creates a larger collector current Ic.

It is this current that we are interested in, since the base current is usually so small and is only required to get the collector current started.

Most electrons which leave the emitter follow a path around the collector circuit and return to the emitter. The Ic current is, therefore, the same as the emitter current for all practical purposes.

Note that the bias voltage necessary in this case is only .2 volt and it may be obtained from a fixed resistor voltage divider once the proper value of R1 has been obtained.

In a PNP transistor, the same basic facts hold true, except that the internal polarity of the transistor is reversed. This makes it necessary to reverse the battery which causes current to flow in the opposite direction from before.

A forward bias voltage between base

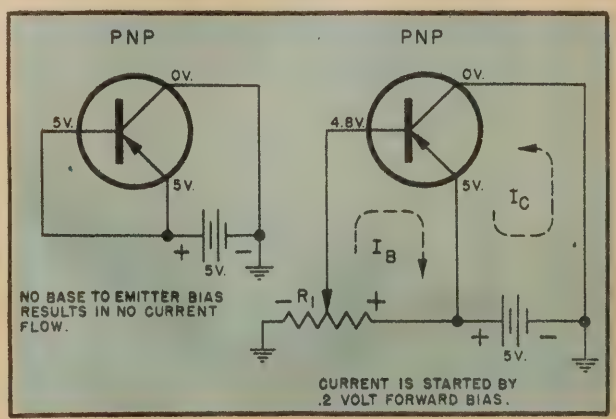


Figure 8: Electrons flow in the opposite direction in PNP circuits (see arrows) the battery also being reversed from the NPN case.

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and emitter is still necessary but the polarity is reversed to coincide with the transistor polarity. The emitter is now the most positive element in the transistor.

The collector current Ic is still the important current and since it is much larger than Ib, the current flowing around the collector circuit is essentially the same as the current in the emitter circuit.

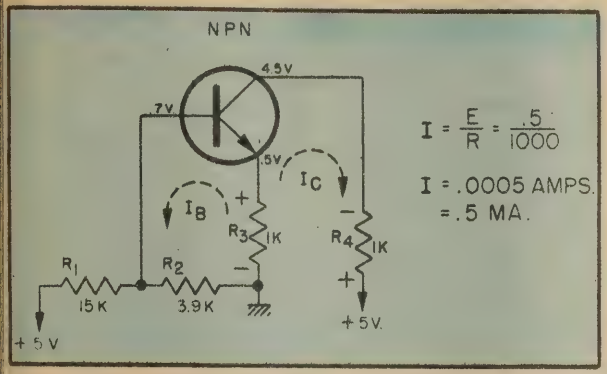

Figure 9 (right): Resistors R3 and R4 stabilise the circuit, and the voltage drop across one of them, divided by the resistance, gives the value of collector current.

Figure 9 has the same circuit but stabilising resistors have been added. The bias adjustment pot has been replaced by fixed resistors R1 and R2 to provide the same voltage relationship.

Resistors R3 and R4 help to keep the collector current Ic from varying due to temperature changes in the transistor. Resistor R3 has more effect in this respect than R4 because it determines what the emitter voltage will be.

If collector current increases for some reason, there will be an excessively high voltage drop across R3 and R4, which will cause a higher than normal voltage at the collector and the emitter voltage will be dropped further away from the 5-volt battery source. In other words there will be less voltage across the transistor to sustain the increased current.

VOLTAGE DISAPPEARS

If, however, the collector current stops flowing, the voltage across R4 will disappear and the collector will go to ground potential, the voltage drop across R3 will disappear and the emitter will be at the full source potential of 5 volts.

Presence of these resistors makes it possible, often, to deduce current flowing through the transistor, without unsoldering leads.

Since the voltage drop across a resistor is equal to the current through it times its resistance value (E=IR), the voltage at the emitter is a good yardstick for estimating how hard the transistor is conducting. See Fig. 9.

By transposition I =E/R.

In this case:—

$$Ic = \frac{.5 \text{ (voltage drop)}}{1{,}000 \text{ (ohms)}} = .005 \text{ amp}$$

Moving the decimal to the right three places, it is found that our transistor is drawing .5 milliamperes of static current.

The same reasoning can be applied to the collector resistor R4, since it is also 1,000 ohms in this case and has .5 volts across it. So, where resistance is present in both emitter and collector circuits, there are two possibilities for quickly estimating collector current by a simple voltage reading.

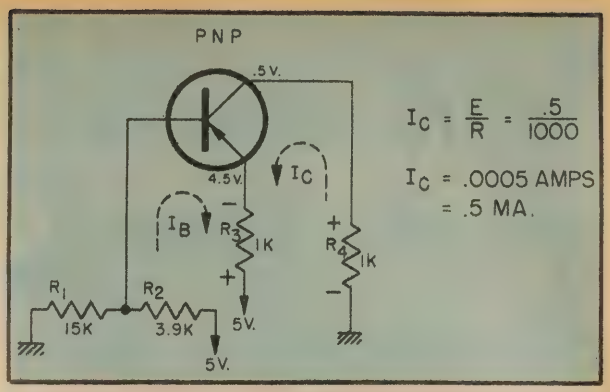

Figure 10 (left): Collector current is calculated by simple Ohm's Law. I—current; E—voltage across R3 or R4; R—value of resistor concerned.

In some circuits one method is more convenient than the other, depending on the values used. Occasionally one of the resistors is omitted but seldom does a circuit contain no stabilisation.

The same basic facts can be applied in an NPN transistor circuit. Stabilising resistance has been added and the collector current Ic must now flow through R3 and R4.

Again the current is 0.5 milliampere, which produces a voltage drop of 0.5 volt across the 1000 ohm resistors. This puts the emitter up 0.5 volt from ground and drops the collector voltage down 0.5 volt from its 5.0 volt source connection.

If no collector current were flowing, no voltage would be dropped across the resistors and the emitter would be at ground potential and the collector would be at the full 5 volts. If, however, collector current should increase for some reason, the emitter voltage would increase and the collector voltage would drop from normal.

After DC conditions are set properly, the signal is ready to be added. The signal whether it be RF or IF or audio will vary or modulate the static current above and below the fixed bias point. The purpose is to obtain the same waveform in the output but amplified from the input.

Notice in figure 11 that coils L1 and L2 have been added in the base and collector circuits of our previous circuits. These will not upset the DC conditions, because they have very low DC resistance. But the signal is now injected in series with the base circuit and this varies the base voltage as shown.

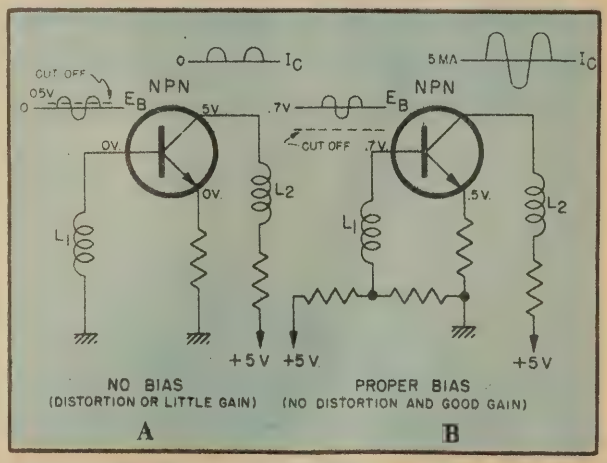

Figure 11: Effect of proper bias is illustrated by output obtained when signal is added. At left, transistor is cut off for a large portion of the input cycle.

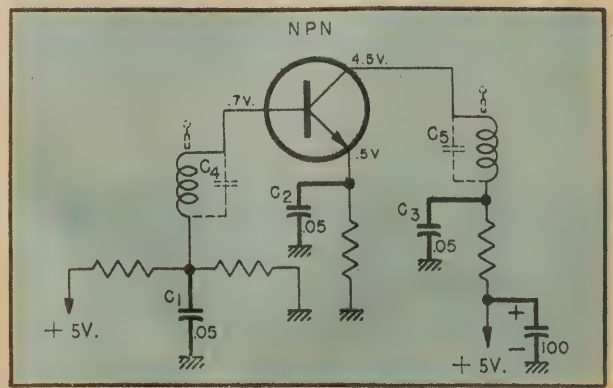

Figure 12: Bypass capacitors are added to the "DC circuit" to prevent circuit instability and loss of signal in the resistors.

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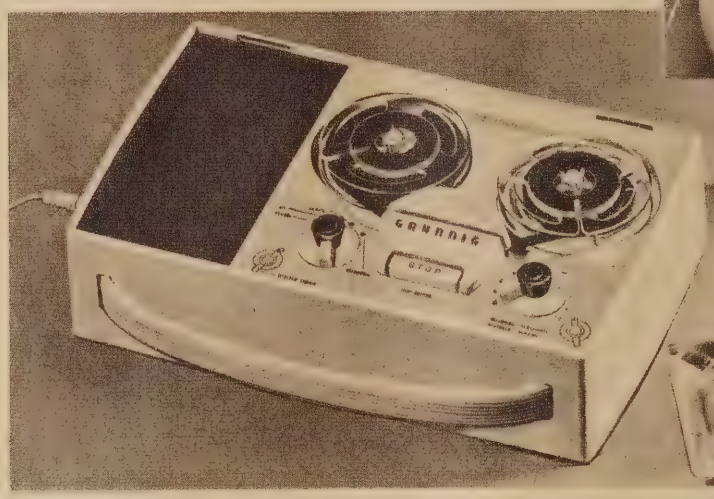

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In figure 11B the transistor is never completely cut off because it has the proper forward bias difference between base and emitter. The collector current is, therefore, varied at an amplified rate and with no distortion.

However, in figure 11A, the DC circuit has no bias and the same input signal does not cause conduction except during a small time at the positive peak of the signal. As a result, much of the signal is lost in the output and it is distorted.

In audio stages this would mean a weak, distorted set. In an IF stage it would mean a weak or dead radio and in an RF stage, where the input is small, it would probably result in a dead radio.

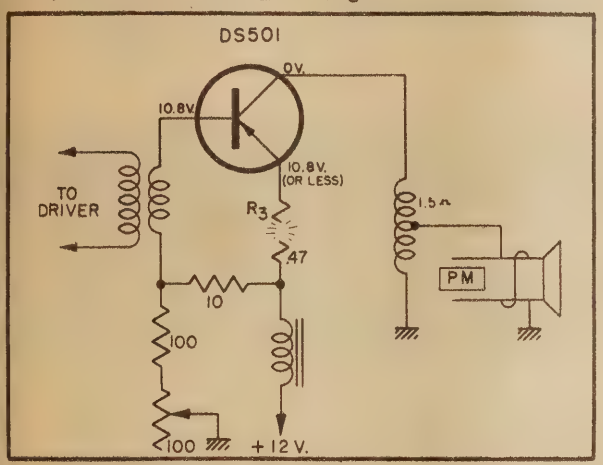


Figure 13: With the circuit configuration as at right, if the transistor is conducting, a voltage can be read at the transistor collector.

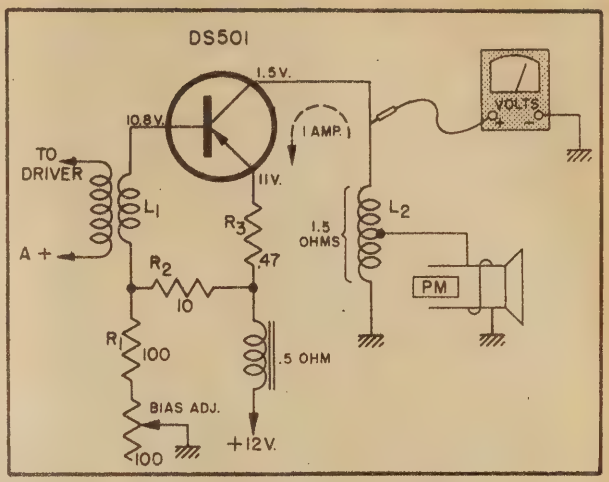


Figure 14 (left): With an open emitter resistor, collector voltage is negligible.

To prevent some of the signal from being lost in the resistance of the DC circuit, the resistors are usually bypassed (see figure 12). Base, emitter and collector resistors have capacitors of about .05 mfd. across them and the line filters are from 20 mfd to 1500 mfd.

An open capacitor could cause a weak, distorted radio or could cause oscillations and whistles, motorboating or other forms of instability.

ISOLATING TROUBLE

Before we see how to troubleshoot a defective stage, let's talk about isolating trouble to or away from the transistor output stage in hybrid auto radios. Too much time is sometimes wasted in troubleshooting the output stage when the trouble is located in a tube stage.

The first step in this type of radio is to put your ear to the speaker, turn the radio on and listen for that familiar "thump" which is a characteristic of power transistor output.

The reason for it is that the transistor requires no warm-up time, and that the first surge of current causes a slight deflection of the speaker which can be heard. If this sound is normal, the chances are that the transistor is working and any trouble is in the tube stages.

If doubt exists, measure the power transistor's collector voltage.

The presence of collector voltage is a criterion for gauging collector current in a PNP circuit where the collector returns to ground through a resistance. In this type of Delco radio, the collector is grounded through an output transformer winding and the collector voltage is normally 0.8 to 2.0 volts, depending on the model. This can usually be checked easily in the car.

If no voltage is present, it means that there is no power to the transistor or there is a defect in the transistor circuit. If the voltage is normal, it means the transistor is conducting and doing its job.

This check applies to the circuit in figure 13 only, as some other sets use a grounded collector circuit where the collector is bolted to the chassis and is always at ground potential.

Figure 13 is a circuit diagram of a typical PNP output stage used in these radios. The base-emitter bias is set by R1, R2, R3, and the bias adjustment potentiometer. Note that the emitter is .2 volt more positive than the base, which is the proper polarity direction for a PNP transistor. R3 also acts as a fuse for this stage since all of the collector current flows through it, and it is constructed to open quickly with overload.

The path of collector current is also through the output transformer L2, which in this case has a resistance of 1.5 ohms with speaker connected. With 1 ampere of collector current flowing through 1.5 ohms of resistance the voltage across the output transformer measured from collector to ground is 1.5 volts. (E=IR.)

As the current increases, the collector voltage will increase, which means that the current can be set by reading collector voltage, instead of opening a lead and reading current.

The value will vary with the model, since transformer resistance and rated

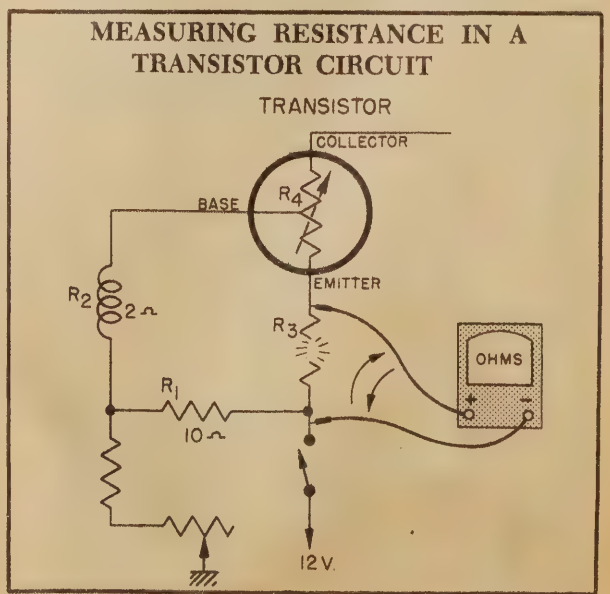
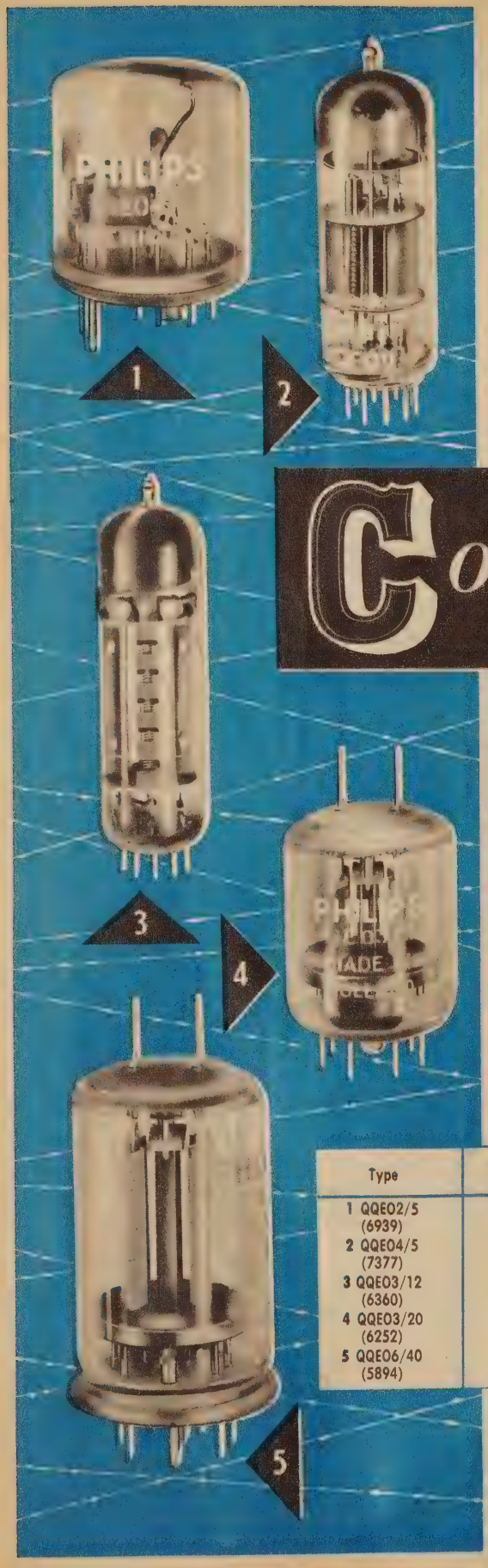


Figure 15: Here the transistor is "forward biased" by the ohmmeter and becomes a low resistance. Always reverse the leads and use the highest reading.



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Type	Max. Power Input (watts)	Max. Power Output (watts)
1 QQE02/5	14 icas	7.5 icas
(6939)	12 ccs	5.8 ccs
2 QQE04/5	10.8 icas	8.0 icas
(7377)	10.8 ccs	7.0 ccs
3 QQE03/12	30 icas	18.5 icas
(6360)	22.5 ccs	14.5 ccs
4 QQE03/20	112 icas	
(6252)	90 ccs	
5 QQE06/40	150 icas	96 icas
(5894)	120 ccs	90 ccs

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current vary, but the proper voltage can be obtained by referring to the schematic. The supply voltage must be set at exactly 12 volts for this check.

Probably the most common defect in a power output stage is an open fuse resistor R3. When this occurs, the voltage will measure approximately as shown in Figure 14. Collector voltage drops to 0 because there is no current flow through the output transformer. The emitter element takes on the base potential because the transistor is a solid device with low internal resistance. Actually, the emitter may read less than 10.8 volts when measured with some meters.

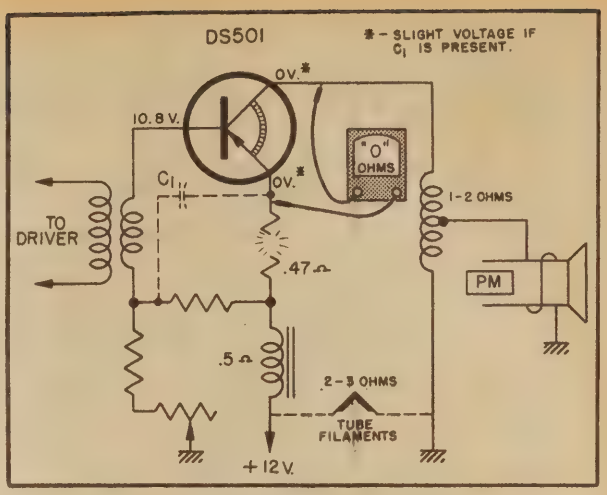


Figure 16: Transistor shorted and emitter resistor open. Collector reads the same voltage as the emitter.

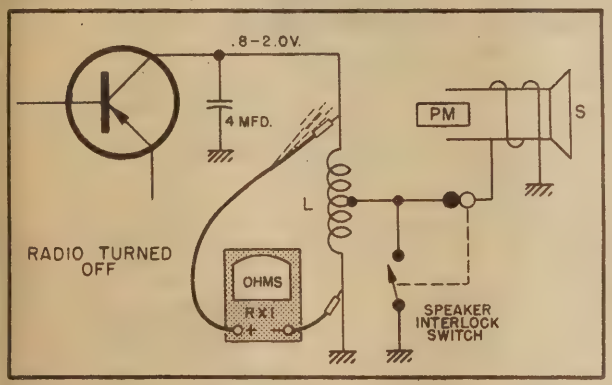


Figure 17 (left): With radio turned off, touch ohmmeter (R x 1 Scale) on and off the transistor case. A click is heard if L and S are good.

The next step in diagnosing this trouble is to turn the radio off and measure resistance across the resistor R3. If more than one ohm, the resistor may be considered open.

When measuring resistance in a transistor circuit, the internal resistance of the transistor again comes into the picture.

For example, in the partial schematic shown above with R3 open, the transistor is shown as a variable resistance, which it actually is. The internal resistance depends upon the voltage and polarity placed on its elements.

Even though power is removed from the radio when measuring resistance, the ohmmeter has its own battery source of 1.5 to 3.0 volts. This means that if the leads are placed in one direction, the transistor resistance R4 will be fairly high, probably in the thousands of ohms in most cases.

However, if the leads are reversed, the transistor becomes a low resistance of only a few ohms. Thus, in this circuit we are actually measuring the resistance of R1, R2 and R4, in series, because they are shunting the fuse resistor, R3.

In one direction of the meter leads 15 ohms will be read in this case and, in the other direction, the resistance will be much higher.

The general rule is to always measure a resistance twice in a transistor circuit with meter leads reversed the second time and use the highest reading. This is when the transistor resistance has the least effect on the resistor or coil being measured.

Sometimes, but not always, when the fuse resistor opens, it is caused by a defective transistor. When a power transistor goes bad, it almost always completely shorts between emitter and collector. When this happens, both the collector and emitter voltages drop to zero and the resistance between emitter and collector are absolutely zero in both directions of the ohmmeter leads (Fig. 16).

Normally, before any defect occurs, the DS501 transistor measures 2-6 ohms between emitter and collector when connected in the circuit. This is mainly due to the low resistance around the "A" circuit from the emitter circuit through the tube filaments and back up through the low resistance of the output transformer. (When disconnected from the circuit, a good power transistor measures over 50 ohms if cooled to room temperature).

However, if shorted, the resistance will be 0 ohms and will not change when the meter leads are reversed. The open .47 ohm resistor with transistor shorted will measure over one ohm but will read a fairly low resistance due to the shorted transistor.

When checking a dead radio in which the lack of a "thump" points to trouble in the output stage, don't be fooled by a defective speaker, speaker interlock switch or output transformer.

To get a fast check on the ability of these to pass signal, turn the radio off and set the ohmmeter on the R x 1 scale. Ground one lead to chassis and touch the other lead on and off the transistor case (collector). A "pop" should be heard as this is done and, if not, something is wrong in this circuit.

Possibilities are: speaker interlock switch not opening when speaker is connected; defective speaker; defective transformer; or shorted collector bypass capacitor. Most defects in the output stage, except for defective speaker or interlock switch, will cause the collector voltage to be abnormal.

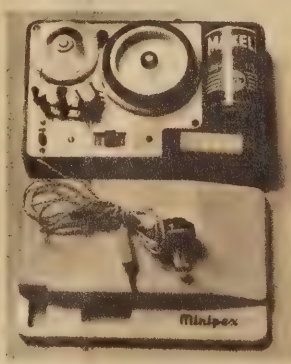
To sum it up, we can say that the largest percentage of troubles in a hybrid auto radio will be in the tube stages. The transistor stage should not be suspected unless the isolating thump test shows no thump or the transistor collector voltage is not near normal.

Never ground the base of a power transistor as it will be damaged.

SUMMARY OF INDICATIONS

	Collector Voltage	Base Voltage	Emitter Voltage
No defect	0.8 to 2.0	About 10.8	11.0
* Open fuse res.	0	About 10.8	10.8 or less (Depends on meter)
* Open fuse res. and shorted trans.	0	About 10.8	0.

* There will be no "thump" in speaker when radio is turned on. This points to trouble in output stage, speaker or "A" supply.



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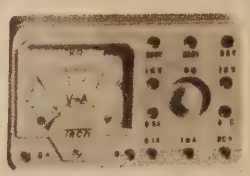

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1C4 ..... 7/6	6SA7GT 9/6	1L5 ..... 9/6	7C7 ..... 3/6	EF50 ..... 2/6
1T4 ..... 4/6	6SH7 ..... 5/6	6C8G 5/	7S 7/6	12SH7 ..... 5/
3S4 ..... 10/	IQ5G 4/	6SS7 ..... 8/6	EL32 ..... 10/6	6K7G 4/6
1R5 ..... 10/6	1P5G 2/6	6H6 ..... 2/6		1C6 ..... 7/6
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AN AMPLIFIER LEVEL INDICATOR

Amplifier level in halls, churches, theatres, etc., can be set without guesswork if a Level Indicator is installed. This article explains how it can be done, using an ex-disposals milliammeter, a potentiometer and four germanium diodes.

WHEN operating an amplifier or 16mm talkie system from a position where the main loudspeaker cannot be clearly heard, it is often difficult to judge the sound level. If not accurately set, the audience either have to strain their ears, or they may alternatively be deluged with unwanted sound volume.

A monitor speaker adjacent to the operating position is of some assistance but is not an automatic guarantee of correct sound level. This becomes all the more true, if the monitor speaker carries its own independent volume control or if the system is used by more than one operator.

METER IN CIRCUIT

The most satisfactory method of maintaining the right volume is to have a meter in continuous operation, reading the level across the speaker line. Where the line operates at an impedance of 15 ohms or more, there is usually no difficulty in obtaining adequate deflection from a sensitive meter, operating directly from the line.

Since the voltage across the speaker line is alternating, the meter must register on AC. Normal practice is to use a DC "moving coil" meter in conjunction with a rectifying system and a multiplier resistor to provide the right order of sensitivity.

In recent months, some excellent Japanese "Level Indicators" have been made available locally, suitable for connection across loudspeaker lines. Most of these have involved a sensitive DC meter movement, a rectifier and a potentiometer with calibrated knob, which could be set to give the required order of sensitivity.

While such instruments are just about ideal for the purpose, they do involve new expenditure, whereas readers may wish to press into service a meter movement which is already on hand.

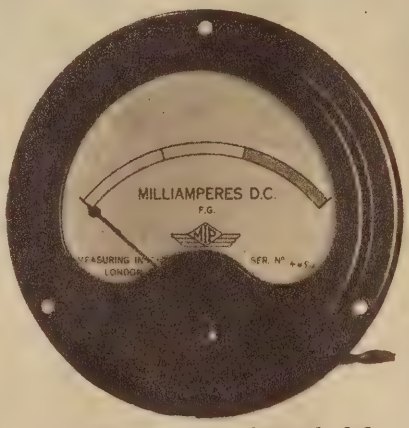
SENSITIVE TYPE

In actual fact, not all the odd meters which may be on hand are necessarily suitable for use as a level indicator.

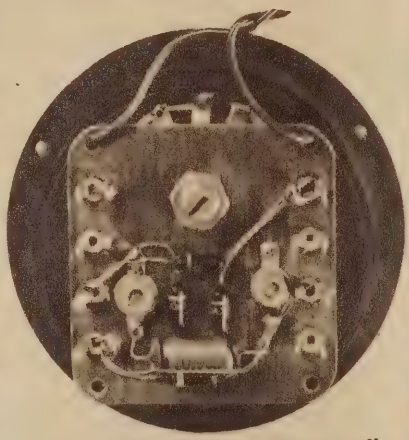
Firstly, a fairly high sensitivity is desirable, so that the meter, rectifier and its multiplier resistor can be connected across the speaker line without loading it to a substantial degree.

Secondly, the pointer movement should be fairly heavily damped so that it will not just oscillate to and fro when fed with an erratically varying audio voltage. In fact, meter movements designed for use as level indicators are designed to respond quickly to any applied voltage, but with a minimum of "overshoot" beyond the value to be indicated.

The accompanying photographs show a level indicator which was made up from a 1-milliamp meter, of a type sold in large quantities through disposals. These meters are of the 4-inch variety



The scale of this ex-disposals 0-1 milliamp meter is divided into green, yellow and red regions for ease of monitoring.



The associated components are all mounted on an addment terminal panel attached to the rear of the meter. Note the end of the potentiometer shaft, cut for screwdriver adjustment.

and, in many cases, had a scale blank but for two arcs adjacent to the tip of the pointer.

The meters were never famous for their ability to withstand gross overload, but there is no reason why they should not perform satisfactorily in the "active" but not otherwise onerous role of a level indicator. They have a certain amount of overshoot but not enough to prevent their being useful, while the large open face would be an advantage in most cases.

Some control over the meter's behaviour can be exercised by connecting a high-capacitance low-voltage electrolytic across the meter terminals, the storage effect tending to retard both the build-up and disappearance of voltage across the moving coil.

The capacitor seen in the photograph is a 100mfd 3V type.

A quite linear scale response, with maximum sensitivity is obtained by using, with such a meter, a bridge rectifier made up from four germanium diodes. While, in detail, types with low forward resistance would have some advantage, satisfactory results would probably be obtained from any general-purpose germanium diodes bought over the counter.

The circuit arrangement is as shown. Note that the diodes must be connected as indicated, the positive (or cathode) ends being usually marked with a dot or band.

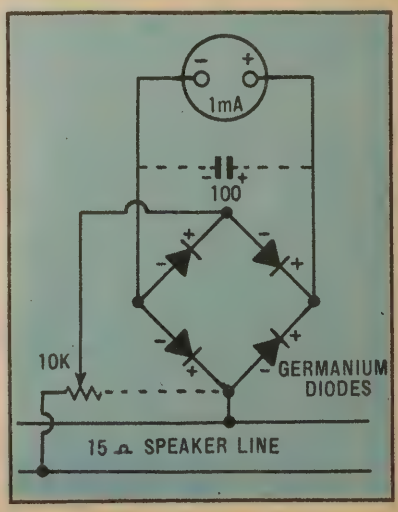
POT. CONNECTIONS

By using the potentiometer as a simple series element, a maximum amount of resistance can be included in series with the meter for any required order of sensitivity. This will ensure, in turn, a more linear response and minimise crowding of the scale towards the left-hand side.

However, the meter cannot be turned "off" with a simple series resistor and, if it is made too large, with an eye to obtaining wide control, it is likely to be very critical when a low value of series resistance is called for. A suitable compromise can be effected by using a potentiometer having a value three or four times that likely to be required from a simple series resistor and connecting the potentiometer right across the line, as shown dotted.

The values shown proved to be quite suitable for use across a 15-ohm speaker line, operating at average powers up to about 4 watts. With a higher average power or at a higher line impedance, both of which would involve more available audio voltage, it would be desirable to increase the value of the potentiometer:—

(a) To take advantage of the better linearity which the higher voltage range would give and,



Here is the circuit of the level indicator. Special care is necessary to avoid confusing the polarity of the diodes.

(b) To keep the potentiometer value well above the line impedance and therefore minimise dissipative losses.

For speaker lines lower in impedance than 15 ohms, the audio voltage developed at moderate power levels may require the meter to have a very low voltage range (e.g. 2 to 5 volts) with rather poor scale linearity.

In such a case it may be an advantage to use a transformer to step up the line voltage to a more manageable figure. For example, an oddment 15-ohm output transformer could be connected across a 2-ohm line to give a useful voltage step-up, without danger of the transformer loading the line adversely, no matter how modest its original design.

SCALE MARKINGS

The meter scale can be graduated in any desired fashion but, for a level indicator, simplicity has much to recommend it. In the meter pictured the scale was divided into three equal regions and painted (with the aid of a water colour set) green in the left-hand sector, yellow in the centre and red in the right-hand sector.

There was a real reason for this multi-coloured effect. For talkie sound or other occasions where the sound is featured, the meter can be set to run into the red region on occasional peaks, only rarely hitting the right-hand stop.

For "background" or "mood" music, where the foregoing level would be much too high, the pointer can oscillate mainly in the green region, only hitting the yellow on peaks and perhaps reaching the red region not at all.

In other words, the operator (or operators), don't have to remember figures. They merely have to remember to keep below the yellow or keep below the red, depending on whether the sound is intended as background or is to be dominant.

Some experiment may be necessary to determine the best setting for the series potentiometer in the particular location. The apparent "loudness" of sound varies a lot with its character, as also does the degree to which it deflects the pointer. A certain amount of "juggling" of the sensitivity may therefore have to go on before a suitable compromise setting is found.

THE COMPONENTS

In the case of the meter pictured, all the associated components were assembled on a scrap of terminal panel (also ex-disposals) bolted to the meter lugs. The potentiometer, with shaft cut short, also shared this space, allowing the meter to be slid in through its normal clearance hole, with no adjustments visible.

Again this was quite deliberate because, in a fixed installation, a too-readily accessible adjustment is an invitation to fiddle with the sensitivity, leading to inevitable confusion.

However, the potentiometer shaft can be controlled by an accessible knob and calibrated scale if there is a special reason to have it that way.

One final thought: If the meter is used under conditions where erratic monitoring may cause distressing overloads, a silicon diode across the movement may afford useful protection.

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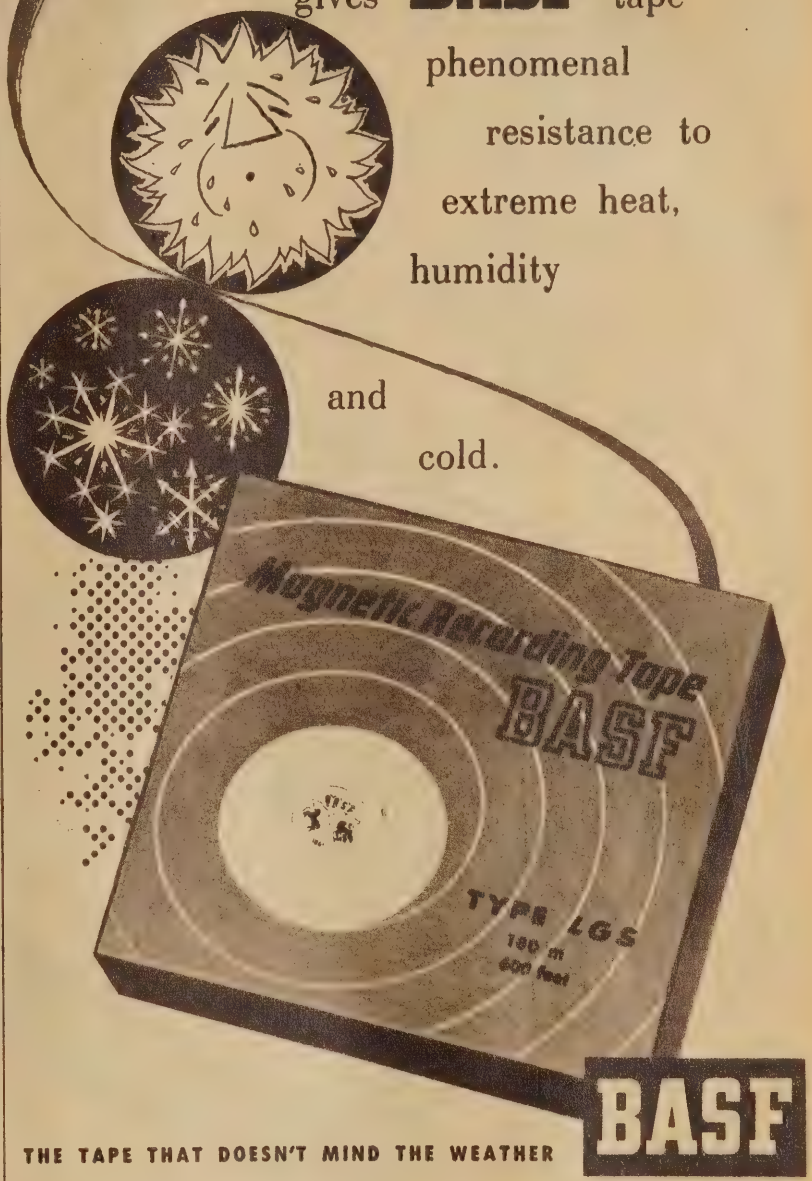

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FROM THE SERVICEMAN WHO TELLS

The reference, last month, to repairing my own test equipment seems to have started something. My first story is again a personal one, though it reminds me of a circumstance which I have seen several times and never ceased to wonder at.

IN my lounge-room is a stereo record-playing outfit which, for all practical purposes, is a "Playmaster" Tuner, Control Unit and Amplifier combination.

As might be imagined, it sounds pretty impressive, and, fortunately, "Mrs Serviceman" thinks enough of it to want it displayed occasionally to friends.

Now, don't get me wrong. I'm not weakening. I haven't suddenly become interested in friends. To radio servicemen they're only a nuisance.

But these occasional "showings off" give me all the excuse I need to play and "select" records and otherwise make noises, when there aren't any friends about.

The other day, while so engaged, Mrs Serviceman betook herself to the telephone to make an arrangement for visitors on the following evening.

"You simply must hear our stereo . . . etc."

That meant that I simply had to "select" and check a few suitable records, but the fates had other ideas. No sooner had the telephone been hung up and the volume restored to normal than the music executed a most delicate fade from loud to very soft, then back to loud again.

DIDN'T HAPPEN AGAIN

It could have been a deliberate "pianissimo" or whatever the long-hairs call it, except that it didn't happen when I played the same track over again.

But it did happen again a few minutes later, this time at a spot where the leading tenor should have been shouting his lungs out. It sounded, instead, as if someone had suddenly borrowed the microphones!

Yes, I had troubles, as well as prospective visitors, so my keen, analytical brain went to work. Ahem!

I had been playing a mono disc with both channels switched in parallel for the purpose. As far as I could judge, both channels had faded. Therefore, whatever effect it was had to be common to both channels.

Since it was a slow fade and a slow recovery, with no clicks to herald either, it seemed almost certain to be a valve heater. Therefore, it had to be a valve common to both channels—which boiled down to a single twin triode.

Or it could be a faulty connection in a heater line, affecting several valves.

So I waited for the next fade and, when it came, I started snooping like Sherlock Holmes. But the heater of the twin-triode remained as bright as ever, as also did the indicator bezel in the front of the Control Unit. This was turning nasty.

So I slipped the Control Unit out of its bracket, turned it over to remove the cover and went probing with a voltmeter, with the gear still in operation.

But there wasn't a volt out of place and no sign of dry joints. What is more, there wasn't a sign of a fade, either, which made me start to suspect the cables. So I clipped the voltmeter on to the B-plus line, in case there was trouble there, and went on listening.

An hour later I was still listening, with no sign of further trouble, so I disconnected the voltmeter, put the Control Unit back together again and went off to bed—rather uneasily.

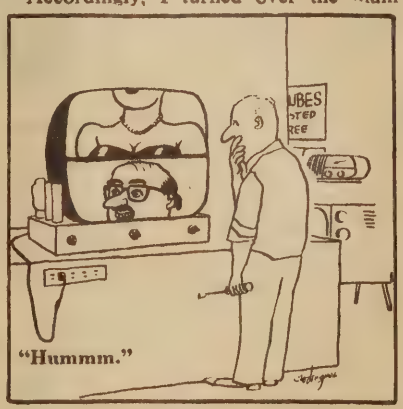
Those visitors, confound them!

VOLUME FADED AWAY

Next afternoon, Saturday, I thought I had better have another look and, sure enough, within the first five minutes the volume had faded away to a mere whisper.

By this time I had begun to suspect that one of the decoupling resistors was playing tricks, dropping the voltage every now and again to the Control Unit. The large decoupling capacitors would explain the slow fade and recovery.

Accordingly, I turned over the main



(From "Radio-Electronics")

amplifier and there was the trouble staring me full in the face.

Decoupling to the Control Unit was through a 5-watt wire-wound resistor, feeding a large electrolytic—500 or 100 mfd, I think.

Running around the resistor, turn by turn, was a pretty little spark; or should I say a ruddy little arc.

Now I could both see and hear the effect.

When the trouble had first occurred on the previous day, the resistor had apparently open-circuited. This had allowed the decoupling capacitor to discharge, and, across the break, the potential had built up to about 300 volts—full HT on one side, practically nothing on the other.

An arc had occurred, the voltage across the capacitor had picked up (as also had the volume) and the arcing metal had temporarily closed the circuit.

But it had broken down again, built up to a new arc, restored the voltage temporarily and so on.

As I sat and watched it, the little arc slowly moved round and round the resistor, following each individual turn. As it did so, the voltage flickered and faltered, and, with it, the volume.

ALWAYS INTRIGUED

I've seen this several times before and, as I said earlier, I've never ceased to be intrigued by the effect. The fact that the arc follows the wire along, turn for turn, means that the wire must be melting in the vicinity of the arc but it also means that it must be maintaining a conducting film of some sort behind the arc, as it moves ahead.

It would be much simpler if the resistor simply open-circuited and stayed like that for the serviceman to find.

The things we servicemen have to put up with. Anyhow, I replaced the resistor ready for the evening, when a good time was had by all—the visitors.

One of the wry sayings of television servicemen is that if there is an open heater in a series-heater string, it will be the last one checked; this irrespective of whether one tries to trick fate by beginning the search at one end or the other—or right in the middle.

Well, that happened to me this month.

The set was reported to me as having "gone dead" all of a sudden and it didn't take long, from a peep inside, to see why. Not one of the valve heaters was alight. The series network was open somewhere.

SERIES HEATERS

For those who might not be quite au fait with the particular problem, it occurs in receivers, normally of the "transformerless" type, having all the valve heaters connected in series and supplied from the mains through a dropping resistor or ballast tube.

If the circuit is broken in any way, then none of the heaters lights up. And of course, this is the case when any one of the heaters fails.

The problem then becomes one of identifying which heater is the faulty one.

"But that's easy," you might protest. "Simply pull the valves out one by one and check them."

Did you say "simply"?

To begin with, the set isn't placed in the room for your special convenience to conduct such a test. It's dark inside the cabinet, so you either peer blindly into the works or go get your trouble light.

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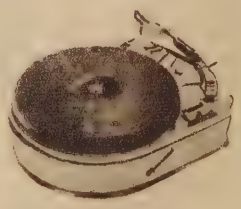

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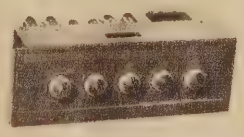

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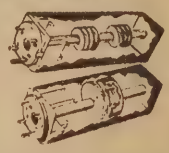

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Even then, it isn't always easy to get at all the valves and to put them back in their sockets without bending a pin or vainly trying to punch a new set of holes in the bakelite.

Then you've got to remember the heater connections for each type, being sure not to miss out on those with tapped heaters connecting to three pins. If you can't remember, or you're not sure, you have to look up the appropriate data book.

You come across one heater that is hesitant and think you've found the trouble, only to discover that the pin is dirty and isn't making good contact with the test prod.

And, of course, as I said at the beginning: The faulty valve always seems to be the last one you come to. Well, it was in this case—a 6BX6 in the sound IF strip.

"JUST A VALVE"

When I mentioned that the trouble was just a valve, I could sense the relief on the part of the owner. The set wasn't insured and he was hoping against hope that the trouble would indeed be something simple, like a valve.

But his relief was not to last long.

Hardly had the set warmed up and put a picture on the screen, than I was treated to the rich smell of charring insulation mixed with ozone. Seeing my consternation, the owner hastened to explain that the set had been exhibiting such malodorous characteristics for some time before it failed. Maybe it really didn't matter.

I'm afraid I couldn't share his optimism for, by this time, I could "see" the smell in the more tangible form of smoke seeping from a louvre in the EHT cage. Carefully slipping the top off the cage, I was treated to a beautiful display of blue corona, etc.

Closer examination with the set switched off revealed the source of the trouble.

In this set, the EHT rectifier and some of its associated wiring was supported in a kind of moulded cradle, which is more or less integral with the horizontal output transformer.

MARGIN OF SAFETY

Normally, the moulding should have had a wide margin of safety in terms of high-voltage breakdown but I can only assume that, in this case, the surface had been fouled by moisture, or by household greases and dust.

The resulting discharge path had led to accumulative deterioration, with the result that the moulding was cracked and charred all around the cap of the EHT rectifier.

I pointed this out to the owner, along with the fact that the proper course was to replace the whole unit with a new one which would cost him several pounds, plus my labour.

"Couldn't it be done cheaper? If it could be patched up for a while, he would be able to afford it better in a few weeks' time . . . etc., etc."

Well, I don't like "patch up" jobs any more than the next man but it was his set and his money—or the lack of it.

So, removing the rectifier from its socket, I set about to break away as much of the charred insulation as I could, but leaving enough to support the rectifier.

The rest I cleaned as best I could, smeared it with silicone grease and put the rectifier back in place. The EHT lead, once supported midway in the moulding, now ran in free air.

Happily, the "patch-up" cure worked and there was no further sign of breakdown when the set was put back in operation.

But I was careful to show the set owner exactly what I had done at his own request, and to point out that the assembly was not as robust as if the part had been replaced.

The set might therefore be hard put to it to withstand a long journey by goods train.

NOT CONTEMPLATED

I gather that no such journey appeared even to be remotely likely.

Mention of valves, earlier, reminds me of another interesting case, this month, involving a television set.

When I arrived at the home, in response to a telephone call, it was to find the receiver in full operation, with picture all over the screen and music all over the room.

This was a little unexpected, to say the least.

It turned out, however, that all wasn't well with the set, despite first impressions.

The picture was rather dull but attempts to make it brighter with the "Brightness" control only caused the picture to expand and lose brightness. There

REBUILT V. NEW PICTURE TUBES

Australian viewers and servicemen can be thankful that they have not been faced with the problem of rebuilt picture tubes, which currently confronts their counterparts in the U.S. The following paragraphs, which are more or less self explanatory, are reprinted from a recent issue of "Sylvania News."

A SET owner whose receiver had recently "conked out" called in a TV serviceman. The serviceman accurately diagnosed the trouble as a dead picture tube and quoted 54 dollars as the price of a new one.

Did the set owner get the new tube he was paying for? In this case he did.

Unfortunately, set owners are not always so lucky. While experience has proved that most TV repairmen are honest, there are still those illegal operators who will palm off a rebuilt tube as a brand-new replacement.

What is a rebuilt tube and where does it come from? It is made from the dead picture tube that the serviceman obligingly removes from your home. He sells it for four dollars to a distributor, who sells it back to a tube manufacturer or rebuilder.

Every tube manufacturer buys back burned-out picture tubes, but the reliable brand-name tube makers reuse **only the glass.** After thoroughly cleaning the tube and removing the phosphor screen from the front a new chemical screen is applied and new electronic elements are inserted.

This used-glass bulb thereafter is processed on the same production line with the new-glass tubes. Even though the glass has been used before, the tube is identical in every other respect with a new one and has the same guarantee.

The process can be compared with the cleaning and re-use of milk bottles. It's how the glass is cleaned and what is put back into it that counts.

Some tube makers don't clean out the old phosphor coating. Some will not use new electronic elements. The tubes that are so produced are properly called rebuilts. These tubes are inferior to new picture tubes made with either new or used glass.

While most set owners are unaware that rebuilt tubes are available, the tube industry estimates there are now some 150 brands of rebuilt tubes on the market.

The Federal Trade Commission has several times attempted to police the labelling of rebuilts. Most of those sold today, however, still bear deceptive labels ranging from "This is a brand-new rebuilt" to "This is a brand-new tube."

Not that there is anything wrong with a rebuilt tube, if it is priced properly. The average suggested retail price of 21-inch rebuilts processed by national brand-name manufacturers is 43 dollars installed, about 11 dollars less than the average suggested price of a brand-new tube.

And a good rebuilt, based on normal use of about four hours daily, should provide two to four years of good service, compared with the five-year life expectancy of a new tube.

A first-quality tube should contain no used material or parts—except that used glass is permissible. The customer should insist that the serviceman use a tube made by a brand-name manufacturer and that he provide the manufacturer's written guarantee. If such proof is not provided, the chances are that the tube contains used parts.

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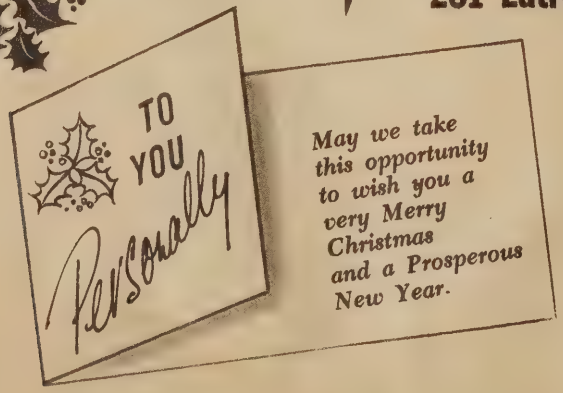

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appeared to be some trouble with the EHT supply.

The contrast was also low but attempts to correct this condition were likewise futile; the "Contrast" control was already fully on.

Normally, such a setting of the control should have meant very high contrast and plenty of noise "grain" in the picture, as well. But the contrast was actually very poor and there was no trace of noise.

In other words, it looked like low sensitivity, as well as low EHT.

Rather speculatively, I replaced the EHT rectifier and noted some improvement in the picture brightness, though there was nothing much to spare. Undoubtedly, the EHT rectifier had been weak, but we were not out of the proverbial woods by any means.

SLIGHT IMPROVEMENT

Thinking of the sensitivity, I replaced the video amplifier valve. Again, there was some slight improvement, this time in the contrast, but not enough to get excited about.

Possibly the high-tension voltage was down?

Unfortunately, I couldn't just plug in a new rectifier, since this set used the "dry" selenium type. I had to do some probing and actually measure HT with the multimeter. Yes, it was down to just under 200 volts but, while this might have affected the EHT quite a deal, it could hardly account for the very low sensitivity.

I began to have my suspicions as to what was wrong.

"How old is this set?" I asked the lady of the house.

"Oh, about four years."

"Have you ever had it serviced in that time?"

"No, never. It's just gone and gone and gone.

"Then it's probably not insured?"

"No, that lapsed years ago—after the first twelve months, I think."

"Well, I think that quite a few of the valves are simply worn out, as well as that rectifier there. My best plan would be to take it back to the shop and test them all thoroughly, so we'll know just where we stand."

Back at the shop, I first set about replacing the rectifier, which brought the HT right back up to normal. In fact, it was a trifle on the high side. Then I clipped the VTVM on to the AGC line and measured a mere volt of control bias. The sensitivity was certainly down.

ONE BY ONE

One by one, I replaced the valves in the tuner and IF strip. With each new valve, the AGC voltage came up another step and, with it, the contrast on the screen.

Subsequent checking verified that every single valve in the receiver had been weak, after the four unbroken years of service.

When I rang that evening to explain the position, I caught the husband at home. It turned out that he was employed, himself, in a semi-electrical position and readily understood about the worn-out valves.

"How many are involved?" he asked.

"About fourteen or fifteen, I think." I knew it was an economy design but I hadn't stopped to count the exact number.

"Look, you'd better replace the lot and be done with it."

This made it delightfully easy—and delightful—for me. The new valves were duly installed and, to check whether the alignment had been upset by so doing, I took a quick look at the response curve. It wasn't quite "copybook" but close enough not to warrant any extensive realignment. Just a mere touch on a couple of slugs and I was prepared to call it quits.

But one rather unpleasant discovery lay just ahead.

With everything restored to normal, the picture lacked the clarity and resolution it should have had. At moderate brightness it wasn't too bad but, with a little more brightness and a little more contrast, there was an unnatural "flatness" about the highlights.

It looked very much as if the picture tube was likewise feeling the effect of the many and the long night vigils. About this, the owner would not be so happy.

When I took the set back on the following evening, I had to break the sorry news and, as I had anticipated, his face wasn't exactly wreathed in smiles. But at least he was philosophical.

He had had a very good run from the set. The picture was much improved from what it had been just previously and he reckoned it would be quite good enough for the time being. He'd call me in again a little later when his bank balance had recovered somewhat from the present impact.

And why shouldn't he be philosophical? Even allowing the cost of the new picture tube, as well as the valves, he was still better off than many viewers who had paid out similar sums for insurance and who didn't have a new picture tube or new valves to show for it.

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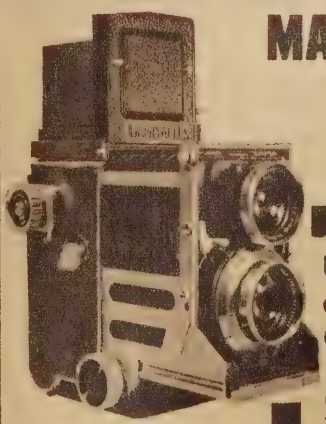

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Shown here is the portable version of the transistor stereo amplifier. The front case contains both amplifier channels, but it may be used alone for mono operation. The second case shown at the rear houses the second speaker and is used to transport records.

Playing Stereo With Transistor Amplifiers

Here are the complete details for the construction of a stereo amplifier having an output of one watt per channel. Operating completely from dry batteries and incorporating transistors, it will enable you to enjoy your stereo discs anywhere. Two versions are presented —a portable version, and one suitable for building into a cabinet for the music lover who is out of reach of power mains.

by Jamieson Rowe

NOT so long ago, it was considered quite impractical to operate record-playing equipment from dry batteries. This was partly due to the lack of a suitable motor-turntable combination, and partly due to the high battery drain involved when reasonable audio power was sought.

Two main problems faced the would-be designer of a battery-powered turntable.

In the days of 78-r.p.m. records, the combination of high turntable speed and considerable pickup drag called for a motor having substantial torque and requiring equally substantial amounts of electrical power.

In addition, it was no easy matter to achieve constant speed and, on a shorter term basis, freedom from wow and flutter.

With the advent of microgroove records and lighter pickups, the power question was somewhat simplified but the problems of speed regulation, wow and flutter became correspondingly more urgent.

The recent advent of single-groove stereophonic records has aggravated matters even further. Stereo pickups are sensitive in the vertical direction and are thus ultra-conscious of turntable rumble and vibration.

However, a considerable amount of work has been done in this field of late, resulting in the release of battery-powered turntables fitted for stereo reproduction, and capable of quite acceptable results.

The battery stereo playing deck shown in these photographs is typical of these new units. It is a Goldring-BSR type RP4BK (cartridge TC8S).

Speed regulation of these units is achieved by means of an electro-mechanical governor and, with careful design, this system is capable of quite good results. Evenness in speed is ensured by careful balancing of rotating parts (often checked electronically) and precision machining.

HIGHER EFFICIENCY

To increase efficiency, motors with permanent-magnet fields are used, and low-loss magnetic materials incorporated. By using improved bearings (self-lubricating types made from nylon, etc.), the overall efficiency of the motors is increased even further.

The result of all this can be seen in the specifications of a typical motor incorporated in a battery stereo player. Such a unit, rated for a nine-volt supply, draws something like 50 milliamps. The power used to drive the turntable is thus a little less than half a watt!

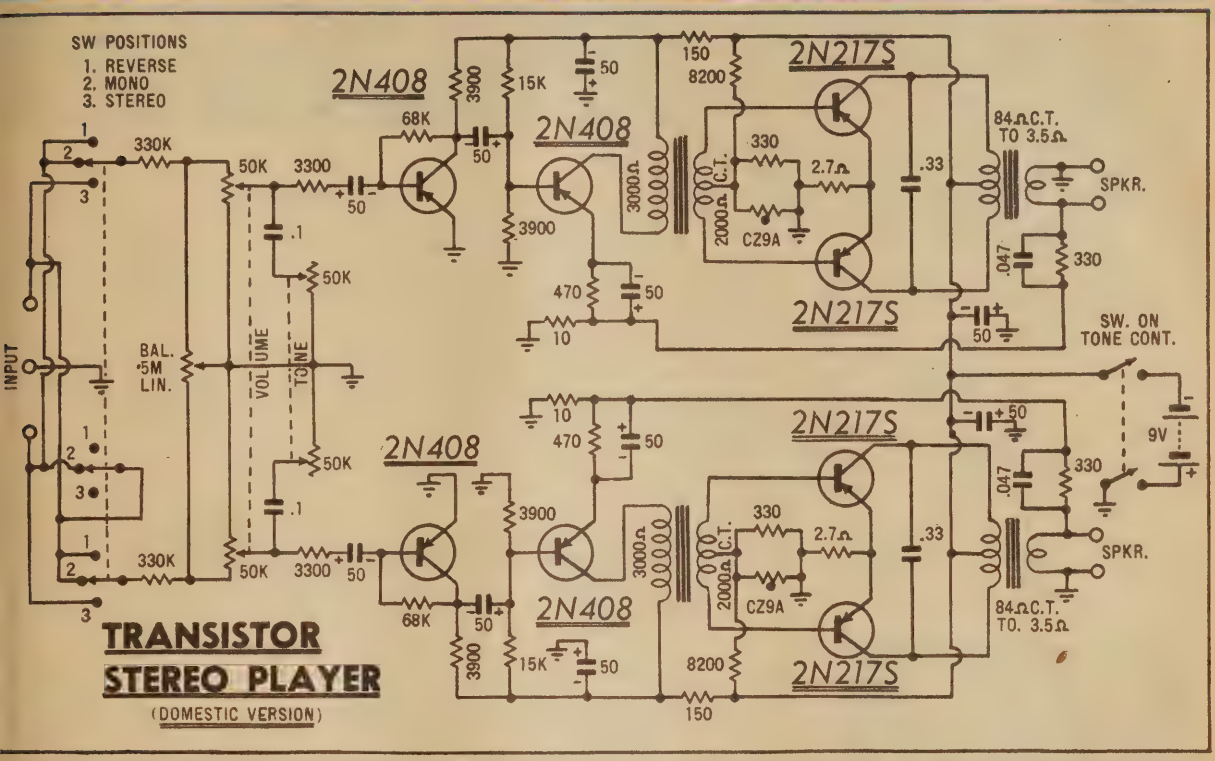
Turning now to the electronic side of a battery record player, we find that the main problem has always been one of amplifier efficiency and battery drain.

In the past, two main systems were used in equipment of this type. Both used low voltage "A" batteries for heating the valves (which were either directly or indirectly heated) but they differed in their HT arrangements.

One used high voltage "B" batteries, and was used in amplifiers using both class A and B output stages. The efficiency of such amplifiers with class A output stages is about 30 per cent, and with class B output stages is about 60 per cent—in both cases neglecting valve heating power, which will lower the overall efficiency still further.

Dry batteries are rather expensive, particularly high-capacity high voltage types. Thus where higher-power amplifiers were needed, it was usual to turn to the other system using vibrator inversion for the HT supply, and either directly or indirectly heated valves.

However, the efficiency of a vibrator supply is about 60 per cent, which means that an amplifier with such a supply and class A output is liable to be only about 20 per cent efficient, and



The complete circuit for the domestic version shows that the unit is basically two four-transistor audio boards coupled to a stereo input circuit. The boards differ from past units, however, in that they each have an output of one watt. Note particularly the altered values of components in the output section, including the new output transformer impedance.

with class B output about 40 per cent. This is still neglecting heater power, which is more for higher-power valves, particularly indirectly heated types.

In other respects, vibrators are not 100 per cent reliable, while careful design is necessary to minimise electrical interference in the equipment, as well as mechanical noise.

It is fairly obvious therefore that valve amplifiers are quite inefficient devices, involving high battery drain. No wonder battery record-playing equipment was considered impractical. The cost of replacing expensive dry batteries was more than the average music-lover's pocket could stand!

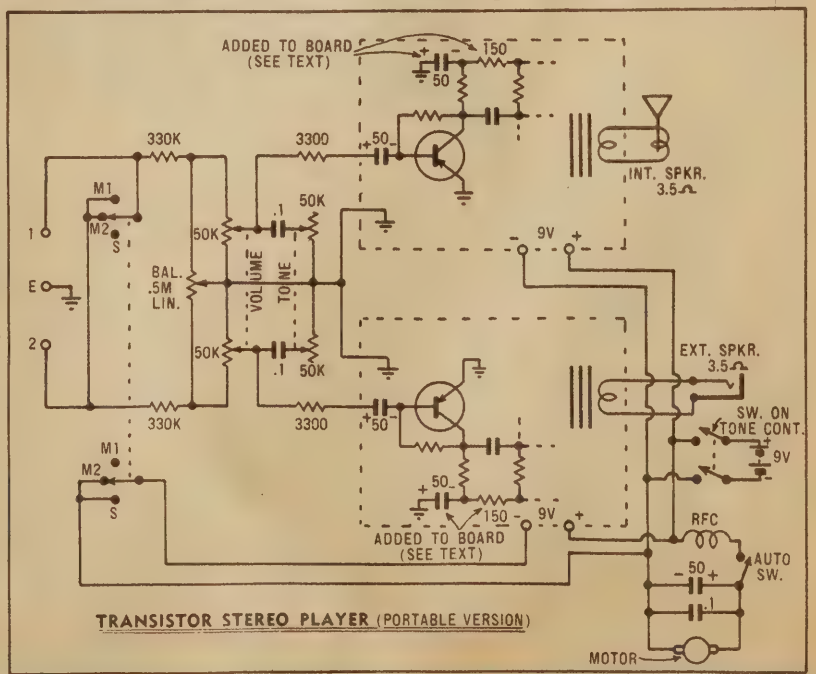
POSITION IMPROVED

Luckily, the development of the transistor improved the position considerably, as it did in many branches of electronics.

Firstly, the transistor requires no cathode heating power, removing the need for one battery. Secondly, the transistor is a low impedance device, and runs at low voltage. Thus the single battery required for transistor operation is a low-voltage type rather than the more costly high-voltage one.

Further, due to the shape of the transistor characteristic, the transistor is a very efficient device. So much of its characteristic can be used in practice that it becomes almost an "on-off" device or switch. With careful design, quite good fidelity may be obtained with transistor class-B output circuits, with a still further increase in efficiency.

Thus we find that transistor class-B output stages (push-pull) may have a PRACTICAL efficiency of something like 78 per cent. Since the output sec-



This circuit shows the alterations made to the domestic version to produce the portable version of the unit. Both the input circuitry and the power supply circuitry have to be altered considerably, and extra decoupling provided for the initial stages.

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tion of the amplifier accounts for most of the current, the effect on overall efficiency will be obvious.

Incidentally, the commonly held opinion that transistor audio amplifiers are inherently poor at the low frequency end is incorrect. The reason why many transistor devices sound rather "tinny" lies in the present emphasis on portability. To date the most obvious domestic application for transistors has been in the field of small, highly compact portable devices, to which they are ideally suited.

However, in such devices ALL the components must be made as small as possible. and this includes the audio transformers. In general, small cores and windings mean limited inductance and poor efficiency at low audio frequencies.

BASS RESPONSE

There is no reason why transistor audio amplifiers cannot be made having good bass response, providing transformers with adequate core sizes are used.

We have been in touch with a number of transformer manufacturers, and the general feeling is one of interest regarding larger transformers having better frequency response. However, they naturally have to consider the market, and some at least wonder whether there is sufficient interest in transistor "Hi-fi" at present.

The response to this article may show if sufficient interest exists to warrant developing appropriate transformers.

For the present, we have achieved a reasonable frequency response from currently available components by a suitable amount of negative feedback over each amplifier. However, more about this later on.

From the foregoing discussion of motors and amplifiers, it is not surprising that, when we noticed the recent release of high-efficiency battery turntables, our thoughts turned to transistor amplifiers. More particularly, they turned to a transistor stereo amplifier.

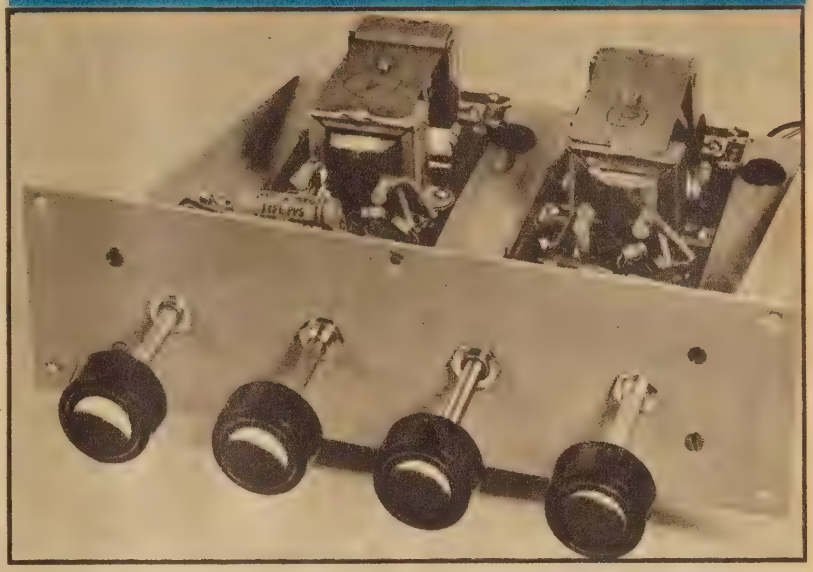
(Editor's note: Latest advice is that supplies of the BSR RP4BK battery player will be very limited until next month. Other components should be immediately available, however.

WIRING BOARDS

Initially, we considered a unit basically comprising two of the 500-milliwatt audio boards, as used in the "Transporta" sets and the "Transistor Eight." However, we decided that this unit would probably have insufficient power for the job, particularly as we wanted it to serve as a stereo set for the country music room, as well as a portable unit.

As it happens, a number of transistor manufacturers have recently developed transistor amplifiers having approximately one watt output, designed around transistors such as the 2N217S and

VIEWS OF "DOMESTIC" VERSION

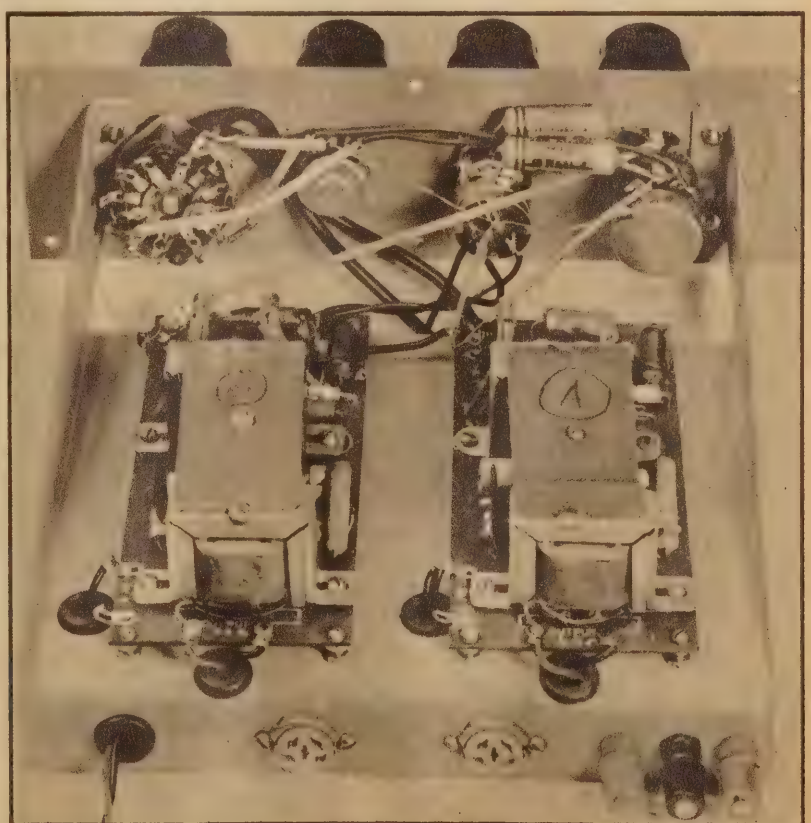


This view of the front of the domestic version shows the four controls and the two amplifier boards mounted on the bracket type chassis. The controls, moving from left to right, are volume, tone, balance and function switch.

OC74. Since this order of power output appeared to be suitable, we examined the various published designs.

Since we had decided to use transistors of the American type (such as the 2N—— series) for this project, the choice naturally fell on a circuit developed by the Amalgamated Wireless Valve Company Pty. Ltd. We therefore proceeded to adapt the circuit for the purpose, aided by some helpful advice and data furnished by the above company.

This does not mean that the unit cannot be adapted for other transistors of similar type. In fact, if other types are used, the circuits may well be taken from the data published by the particular manufacturer. In many cases the circuits are so similar that the changes



This view of the top rear of the domestic version shows the control wiring, the amplifier boards and the input and output connectors. Underchassis wiring may be deduced from this view, as all components are visible.

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will usually only involve bias alteration, etc.

For instance, the basic circuit for each amplifier channel could be taken from the Philips Miniwatt data, if the transistors OC70, OC71 and OC74 are preferred.

Now a few words about the circuit as shown. As you can see, it is basically composed of two amplifiers, each having a preamplifier stage, a driver stage, and a class-B push-pull output stage.

The first stage of each channel is a preamplifier using a type 2N408 transistor.

As in previous designs, this stage uses DC negative feedback to temperature stabilise the operating point. This is achieved by connecting the base bias resistor to the collector rather than directly to the negative supply. Any increase in collector current is offset by reduced bias on the base. Note that there is a certain amount of AC feedback too, since the bias circuit is not decoupled. This helps the frequency response.

DRIVER STAGE

The second stage is a driver, using a 2N408 again. This stage, since it operates at a higher signal level than the first, has a more elaborate bias stabilising arrangement. The base bias is supplied from a resistive voltage divider, and an emitter swamping resistor (470 ohms plus 10 ohms) is included to swamp out temperature variations in the base-emitter junction resistance.

The output of the driver is fed by a single-ended to push-pull driver transformer into the bases of the two 2N217S output transistors. These two transistors are run in class B, to achieve maximum efficiency.

Since the output transistors are operating at a high power level, they may run rather warm. Temperature variations in the various parameters are thus relatively high and, to provide adequate bias stabilisation over a wide range in temperature, non-linear techniques must be used.

Thus we find that the base voltage divider has a temperature-sensitive resistance element as part of its lower component. The variation in the value of this unit (also known as a "thermistor") with temperature matches fairly well the variation in Icbo of the transistor, thus keeping the bias variation within quite narrow limits.

SWAMPING RESISTOR

As before, there is an emitter swamping resistor. It is small in value (2.7 ohms), since the emitter current of both transistors flows through it, making it seem twice the value as far as each unit is concerned. It can be small for another reason—the emitter-base forward resistance of a power transistor is quite low.

(Note: The emitter swamping resistor must be kept as small as possible, since it is, in effect, part of the transistor load and reduces the available power output.)

The power output of each amplifier, when operated from a nine-volt battery, is approximately one watt across the total transformer primary (collector-to-collector). This figure is reached just before overload, with a harmonic distortion of about 5 per cent. The input voltage required at the pick-up terminals for this output is about 700 millivolts.

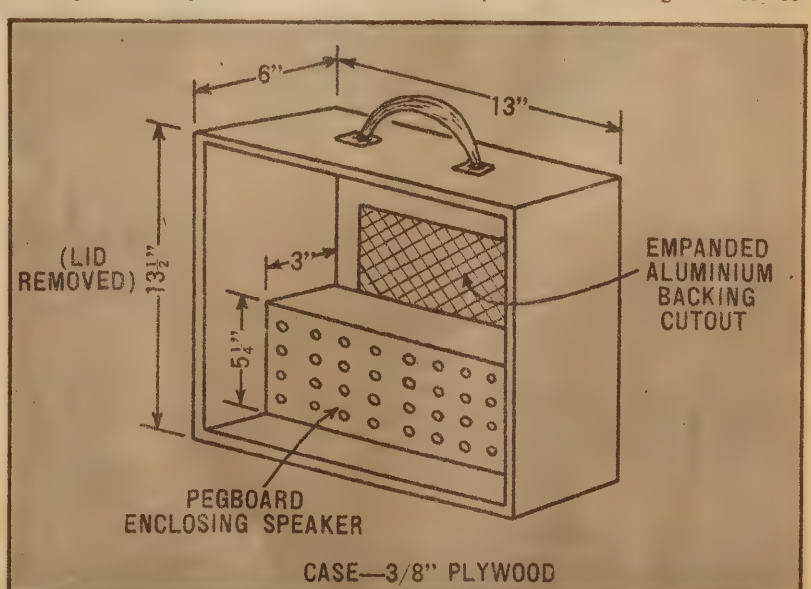
VIEW INSIDE THE PORTABLE CASE

This view of the interior of the portable case shows the small control panel mounted alongside the 5 x 7 inch elliptical speaker. The two amplifier boards are mounted on spacers and screwed to the bottom of the case, with the battery mounted in the rear.

As you may have noticed, negative voltage feedback is used from the output transformer secondary to the emitter circuit of the driver stage. This improves the frequency response of each amplifier and lowers the distortion. With the feedback as shown, the frequency response of each amplifier channel is from 70 cycles to 10,000 cycles between 3 dB points.

As the main circuit shows, the input circuitry is basically similar to that used in many stereo amplifiers. From the input terminals, the signals first pass through a three-pole three-position rotary switch, used as a "Stereo-Mono-Reverse" control. (Note: This switch is modified in the portable version of the unit, due to other factors. However, more about this later.)

Each channel signal then passes through a 330K resistor. This resistor serves two purposes. One is to serve as an impedance "matching" device be-



This sketch shows the design for the second speaker case, which is provided with space for transport of records. Seven inch discs can be carried alongside the speaker, with larger discs in the space above.

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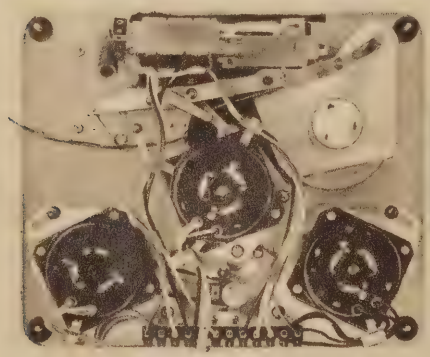

SPECIFICATIONS

Medium	Standard ¼" Plastic or paper base coated tape.
Track Width	.087" - .091".
Number of Tracks	Two.
Record/Playback Sense	Left to Right only.
Number of Motors and Type	Three. Four pole, Induction, dual voltage.
Voltage	200-250V. 50 cycle & 110/50 cycles by change of connections; 110V. 60 cycles by change of motors.
Operating Consumption	Max. 24 watts at 230 volts.
Operating Speeds	1⅞", 3¾" and 7½" per second.
Number of Heads	Two.
Head Types	One Record/Playback, one Erase.
Heads, Additional	Space provided for the fitting of a monitor head or a stereo playback head.
Record Head Gap	.00025".
Record Head Impedance	30 K ohms at 10 KCS.
Attainable Frequency Response	12 KC at 7½" per second ± 3 db with Record/Playback equalisation.
Recommended Erase & Bias Frequencies	45-60 KCS.
Erase Head Impedance	200/300 ohms at 45-60 KCS.
Erasing Voltage	Approximately 25 volts at 120 M/A.
Playing Time	120, 60 and 30 minutes per standard 1,200 ft. reel.
Rewind Times	65 seconds per 7" spool of 1,200 ft. 45 seconds per 5¾" spool of 850 ft.
Wow & Flutter	Not greater than .15% at 3¾" p.s.
Long Term Speed Stability	Better than .5%.
Dimensions	
12½" x 10⅝"	With 5¾" spools within the confines of the Unit Plate. With 7" spools overlapping Unit Plate.
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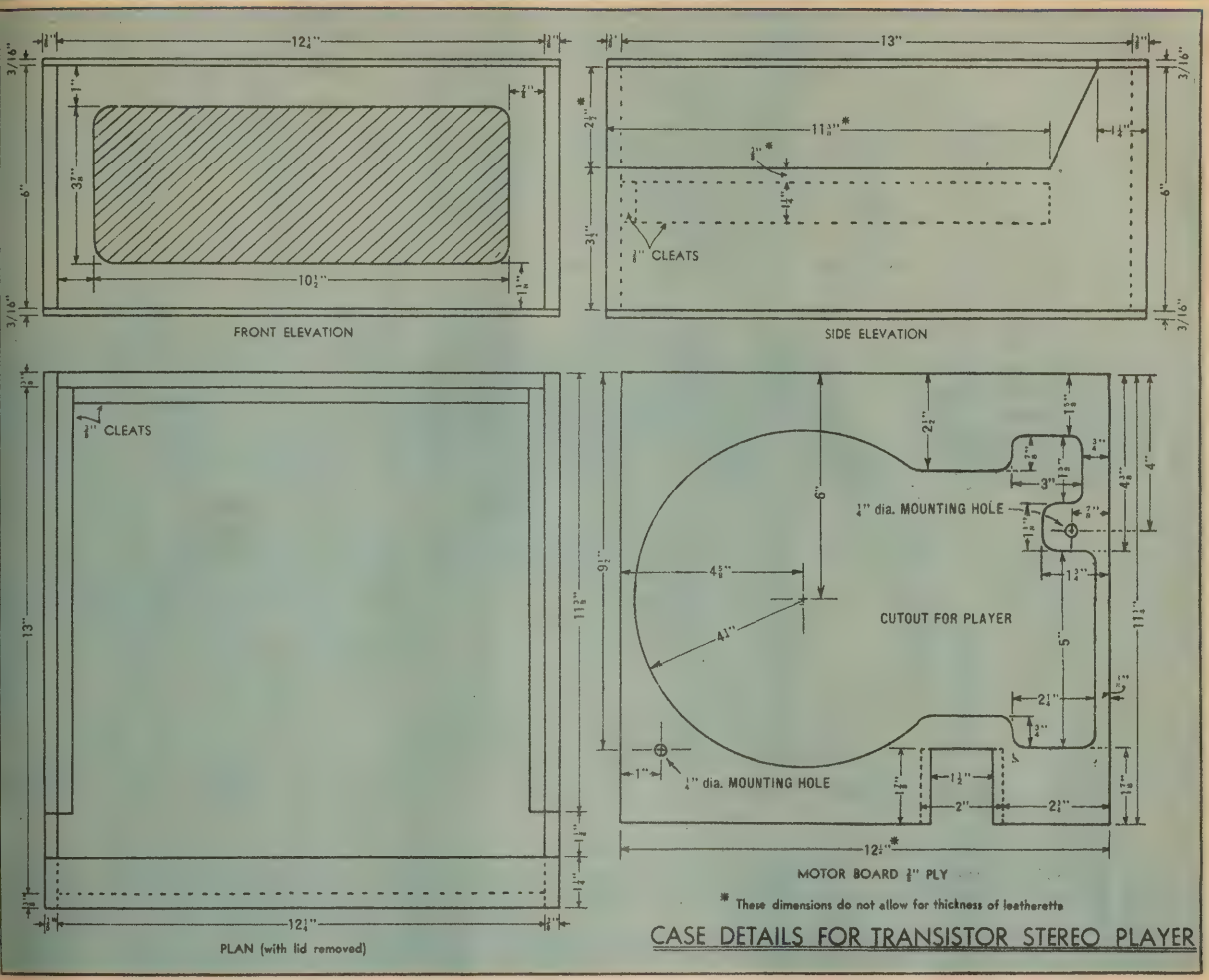
FRONT ELEVATION
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PLAN (with lid removed)
¼" dia. MOUNTING HOLE
CUTOUT FOR PLAYER
MOTOR BOARD ⅜" PLY
* These dimensions do not allow for thickness of leatherette
CASE DETAILS FOR TRANSISTOR STEREO PLAYER

Here are the plans for the player case. Plywood of 3/8in thickness is used throughout, covered in deep wine and beige leatherette. Note the rectangular cutout in the front face. This cutout is backed with expanded gold aluminium grille, in which holes are cut to clear control spindles.

ween the relatively high impedance pick-up and the relatively low impedance nput circuit of the amplifier, and the ther is to isolate the balance control rom the pick-up in the "Mono" posi-ion, allowing for easy balancing.

The balance control is a 500K linear carbon potentiometer, wired with its moving arm earthed. This in effect alters the dividing ratio of each 330K-volume control voltage divider, and thus can be used to balance the overall gain of the two channels. In the extreme position in both directions it cuts one or the other channel off, often a handy feature.

VOLUME CONTROL

The volume control of the unit is a 50K-50K ganged potentiometer, one section operating in each channel. From the moving arm of each control a 0.1 mfd paper capacitor leads to the two sections of another 50K-50K ganged pot., forming a treble-cut tone control in each channel.

The input to each amplifier is also taken from the moving arm of each volume control, via a 3.3K resistor and a 50 mfd coupling capacitor.

The 3.3K resistor is quite important, incidentally. Its job is to swamp out the input resistance of the transistor. If this is not done, the non-linear input characteristic of the transistor causes serious distortion when it is fed from a low impedance source.

Thus with the resistor left out, distortion is obvious at low settings of the volume control or when the tone control is set for maximum treble cut. With the resistor in circuit, however, the transistor is fed from an effectively constant-current source and variations in its input resistance cannot cause distortion.

The power to the complete amplifier is switched by a double-pole switch on the rear of the tone control. This allows the volume control to be left at the normal level setting when the unit is turned off. It also results in less wear and tear on the volume control.

This, then, is a circuit arrangement which can well be built into a cabinet and installed as a fixture in a country home, along with a couple of well-baffled loudspeakers. We have therefore labelled it "domestic version."

For use as a purely portable player different requirements have to be met and we are therefore suggesting a somewhat modified arrangement labelled "portable version."

The function switch circuitry has been altered in this portable version, to allow the unit to operate in three ways or modes: (1) as a single-unit mono player; (2) as a two-unit mono player; and (3) as a stereo player using both units.

PARALLEL INPUTS

In the first position, the two signal inputs are paralleled but the amplifier which connects to the second speaker is turned off. In the second position, the inputs are still paralleled but the second amplifier is turned on, and can be used to operate the second speaker. The third position is normal stereo operation, involving two speakers.

You may ask—"What about the missing 'Reverse' position?" The fact is that the need for such a position is debatable anyway but it is even less important with a portable system.

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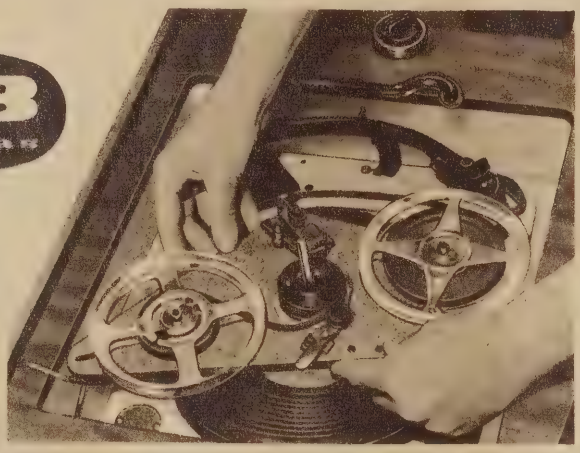
43 GUINEAS



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The cleverness of the Gramdeck is in its simplicity. With no valves or motors to go wrong, it slips onto the turntable of your gramophone as easily as a record. The turntable drives the tape spools and the loudspeakers in the gramophone provide sound reproduction through the ingenious Gramdeck giving you a quality of reproduction that must be heard to be believed.

The Gramdeck consists of two self-contained units — the Tape-deck which is placed on the turntable of any record player and a very neat and compact Control Unit (Pre-Amplifier) with a selector-switch for recording or playing back.

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WESTERN AUSTRALIA — Consolidated Agencies, 1 Howard Street, Perth.

Since, for the true stereo effect, the two speakers must have adequate separation, it is not very satisfactory to have both speakers in the same portable case.

As an alternative, we can have speakers mounted on the two sections of a split lid, to be taken off and correctly spaced for stereo listening. Again, we can mount one speaker permanently in the case, and place the other in a second case.

The first method has the advantage of single-case carrying, but the case has to be quite bulky if speakers of reasonable size are to be used. The second method requires two cases, and thus is perhaps less desirable, but it has a number of advantages which are not immediately apparent. It is these advantages which finally led us to decide upon this style of construction.

The first is that the second speaker case can be used to carry records. This is important, as it does away with the need to balance a large pile of records in one hand, while carrying the player in the other!

MONO RECORDS

The second is that we can use the player unit, with its single speaker, to play mono records. Thus if we only want to play mono, we only have to carry one medium-sized case around. On the other hand, to play stereo, all one has to do is plug in the second speaker.

The auxiliary circuit shows the appropriate modification at the output end. One speaker is connected to its amplifier as before; this is the speaker which is built into the player case, and is the one used for single-case, mono operation. The other amplifier output is fed to a jack mounted on the rear of the case, into which the second speaker plugs for two-speaker mono operation and for full stereo operation.

If one only wishes to carry one case, the player can be used for only single-speaker mono operation. If both cases are used, either two-speaker mono or stereo operation is possible, merely by turning the function switch.

As for the missing "Reverse Stereo" position of the function switch, it is really not necessary in a portable unit of this type, as the second speaker can be put either side of the player unit!

Either that or, if you want the units in a particular relative position, the channels can be changed over to put instruments in their conventional position by changing over the pickup connections.

MODIFIED CIRCUIT

You will notice that the collector supply circuitry for the first transistor of each amplifier channel has been altered in the portable version. This is because an extra stage of supply decoupling is needed to eliminate hash from the motor, which is run from the same battery as the amplifier in this version.

The extra 150 ohm resistor and 50 mfd capacitor will not fit beneath the printed circuit board, and so must be mounted above. We found that they could be connected and mounted on a single tagstrip, as can be seen from the small photograph.

To further reduce the hash, we found it necessary to bypass the motor terminals with both a 0.1 mfd ceramic and a 50 mfd electrolytic capacitor, and to

place a low resistance RF choke in series. The choke should have a DC resistance of from 10 to 20 ohms, and replaces the 15 ohm resistor supplied with the motor.

Both the additional amplifier decoupling and motor filtering will not be necessary if the motor and amplifiers are run from separate batteries, however. This is the reason for these modifications only appearing in the circuit for the portable version, where single-battery operation is desirable.

Now for the mechanical side of the design. We will deal with the original amplifier first, as it is the simpler.

The type of construction used is that involving a panel and bracket chassis, similar to that used in the mains operated "Unit Stereo" amplifiers. The controls are mounted on the panel, and the amplifier circuitry built on the bracket chassis. In our case, we used bakelite printed circuit boards for the two amplifiers, but the amplifiers could just as well be wired under the chassis in the normal way if this is preferred.

INPUT LEADS

As the rear view shows, the volume control is the control furthest to the left (considering the front of the panel; it is the furthest to the right looking from the rear). Then comes the tone control, the balance control, and finally the function switch.

You will notice from the photographs that the input leads are shielded only up to the 330K resistors. Shielding after these is unnecessary, as the circuitry is quite low impedance. This circuitry is rather uncritical as regards layout, for the same reason. The main thing is to prevent feedback loops in earth leads, by avoiding multiple paths.

This applies to the rest of the circuit. However, readers building the amplifiers on commercial printed circuit boards will not need to worry about layout, as there is only one correct way. The circuit for the two amplifiers is exactly the same as that used for the 500 milliwatt board described in a number of previous articles, except for a number of component values altered to suit the new transistors.

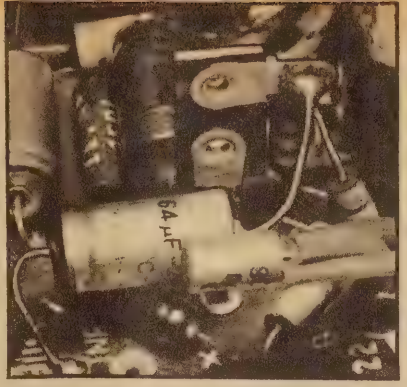
The small pieces of sheet brass which can be seen in the rear view of the amplifier, spot soldered between each pair of transformers, are additional heat sinks for each pair of output transistors. The small heat sinks normally supplied with the transistors are bolted to the brass sheets. This ensures adequate cooling for the output transistors.

INPUT AND OUTPUT

The signals from the pickup are introduced to the chassis via three spring type terminals, and the outputs of the amplifiers fed to the speakers using small five-pin plugs and sockets.

The printed circuit boards are mounted raised from the main chassis, to prevent the chassis shorting out the circuitry. About a quarter of an inch is ample. We used extra nuts on the mounting screws to give the required spacing, but suitable tubular spacers may be used to advantage if they are available.

This completes the description of the original unit, which may be built into a cabinet, and operated with a pair of suitable speakers in enclosures. Indeed, very pleasing results may be obtained with this unit and a couple of medium-quality 12-inch speakers, mounted in "boffles" (see the September, 1958, issue for details on making the "boffle" enclosure).



This close-up of the added decoupling components in the portable version shows the single-tag strip used to support them above the circuit board.

The portable version of the amplifier is constructed in a slightly different way from the first version. Since there are only three main controls on this version, and space is at a premium to conserve portability, the control panel may be made smaller. (The balance control, which is seldom touched once set, has been made into a screwdriver adjustment in this portable version; it is adjusted through a hole in the case.)

The control panel becomes a bracket of aluminium measuring 3¼in by 4in, with a 1in-wide turnup strip along one 4in edge. The screwdriver-adjusted balance control is mounted on the turnup strip, as the internal view of the unit shows.

By doing this, and also by dispensing with a chassis and mounting the circuit boards directly inside the portable case, we found that we could easily fit the unit in a case very slightly larger than the case used for the "Transportagram Six" of October, 1958. This is quite a moderate-sized case, our final dimensions being 13¾in x 13in x 6¼in.

The control panel mounts alongside the 5in by 7in elliptical speaker on the front face of the case. The false front of the case mounts the panel and speaker, and is screwed at the back of a rectangular cut-out in the case front behind an expanded aluminium grille. The case, as before, is finished in beige and deep wine leatherette, with gold anodised-alodised grille and gold highlighted knobs.

THE CONTROLS

Looking from the front of the case, the function switch is at the top, with the tone control below it, alongside the volume control. The adjustment of the balance control is done via a small hole made near the carrying handle.

As may be seen from the internal view of the case, the interconnecting leads between the control panel and the two amplifier boards are left long, to facilitate servicing and inspection.

This completes the description of our new transistorised stereo record player, which should find many uses in the country and in all situations without reliable mains power.

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Today, when keen competition among manufacturers of Tape Recorders is stimulating interest in 4-track heads, slower tape speeds, cassettes and the like, it is appropriate that we should once more re-state the Ferrograph policy.

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Based upon our intimate knowledge of the work being carried out on the Ferrograph, we believe that any widespread introduction at the present time of narrow tracks and slower speeds could lead to a general, and regrettable, deterioration in the standards of tape recording.

We affirm, therefore, our determination to make no compromise with quality. The reputation enjoyed by the Ferrograph will not be hazarded, either now or in the future, by the premature introduction of any features that have not been proved fundamentally sound and in the best interests of the user.

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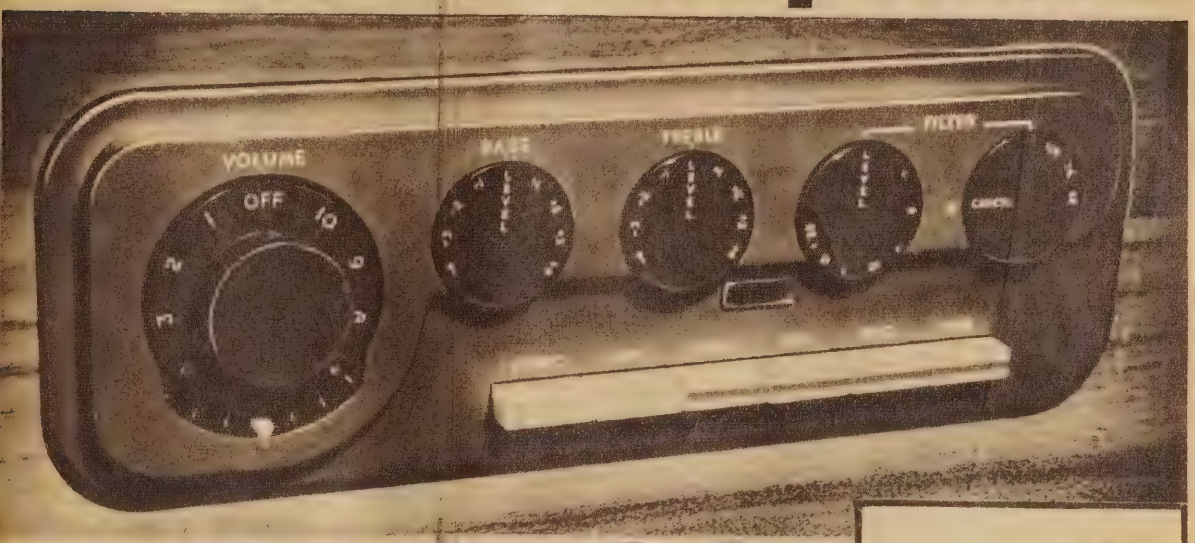

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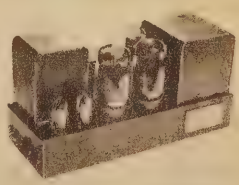

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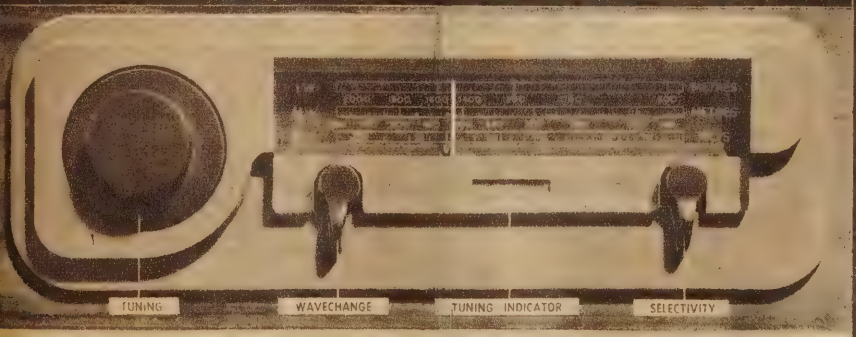

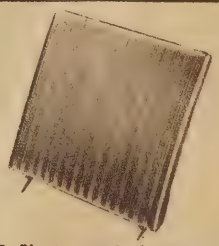

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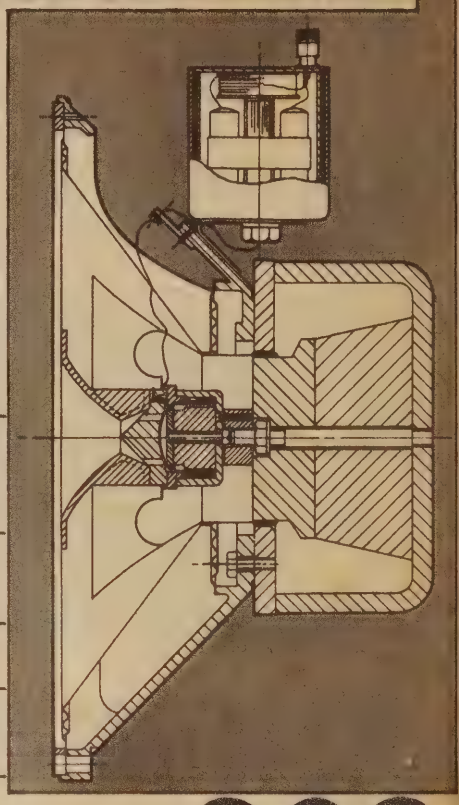

General Specifications

Frequency Range: 30 — 20,000 c.p.s.
Impedance: 15/16 ohms.
Coil Diameter: 3" Bass and Mid-range
1" (Aluminium) H.F. Pressure Driver
Electrical Crossover: 5,000 c.p.s. twin half section
L.C. network 12 db/octave
H.F. Balance Control: constant impedance wirewound
L-pad, 0-15 db.

TYPE	SIZE	POWER HANDLING CAPACITY	FUNDAMENTAL RESONANCE	MAGNET WEIGHT	TOTAL FLUX	BAFFLE HOLE	¼" BOLT CIRCLE DIAMETER
412	12	20 watts	35	3½ lbs.	240,000	11"	11¾"
415	15	20 watts	25	3½ lbs.	240,000	13"	14 9/16"
615	15	25 watts	25	6 lbs.	308,000	13"	14 9/16"

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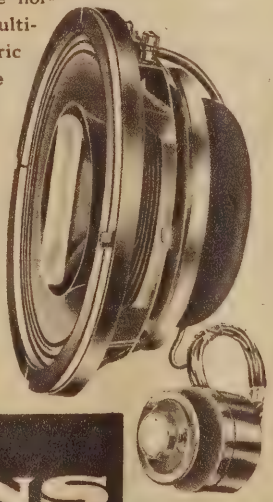

SPECIFICATIONS

Frequency Range: 40 — 20,000 c/s.
Fundamental Resonance: 45 c s.
Max. Power Handling Capacity: 10 watts, 20 watts U.S.A.
Total Flux: 178,000 Maxwells
Voice Coil Diameter: (Bass and Mid-range) 3"
Voice Coil Diameter: (H.F.) 1"
Impedance: 15 ohms at 400 c s.
Baffle Hole Diameter: 7"
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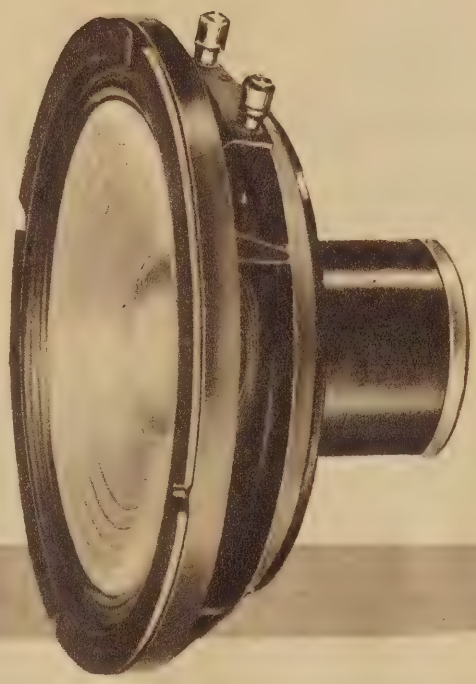

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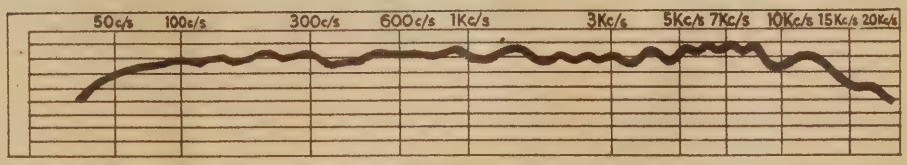

SPECIFICATIONS:

Flux Density: 15,000 gauss. Frequency Range: 40-15,000 c/s. Fundamental Resonance: 65 c/s (nominal). Maximum Power Handling: 7½ watts (15 watts, U.S.A. rating). Impedance: 15 ohms. *PRICE: £16.*

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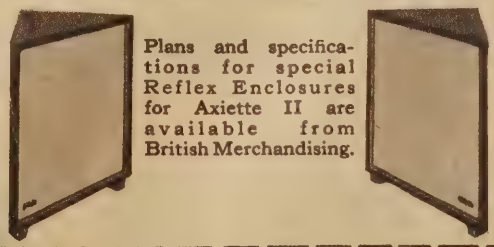

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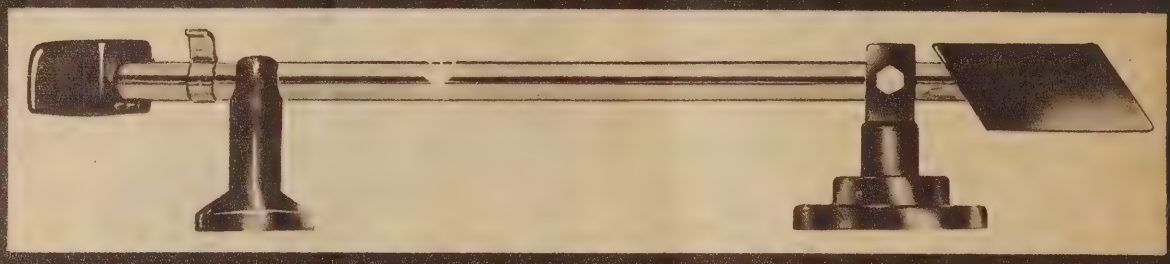

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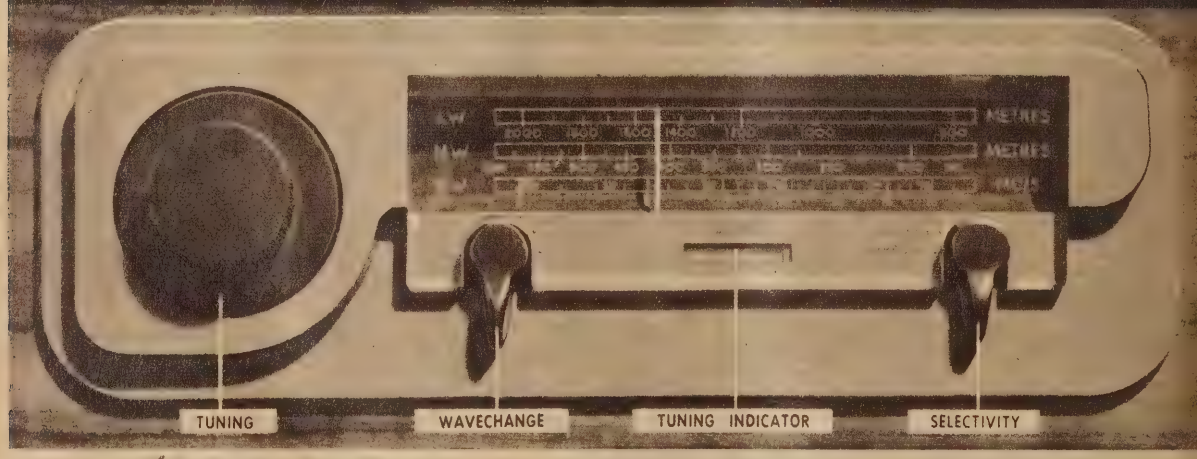

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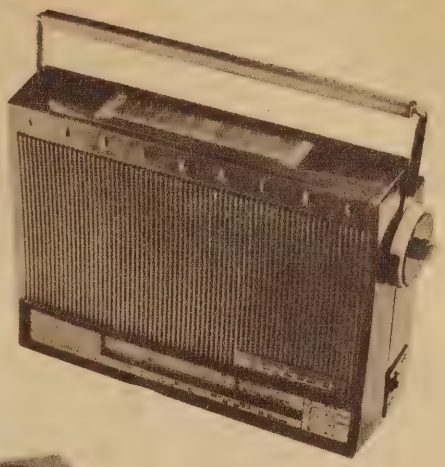
NEW—A SUN-POWERED RECEIVER

The multi-purpose transistor receiver pictured below is the first radio receiver in Australia to be powered by sunlight. Designed and manufactured in this country by Stromberg-Carlson Pty. Ltd., the receiver is due for release at about the same date as this issue.



DESIGNATED the "Wayfarer," the set is a 7-transistor portable designed for use as either a personal portable or a car radio. Accordingly, it has an audio output of about 500 milliwatts, rather more than many portables. Retail price is quoted at 49 gns., comparable with regular transistor car radios.

As a portable, the unit can be operated either from the solar cell battery, or from four torch cells if there is insufficient light. A ferrite stick antenna is used in both these modes of operation.

As a car radio, the unit operates from the torch cells only. The ferrite antenna is disconnected by the "function" switch and a normal aerial coil connected so that a car aerial may be connected to the set. A second tuning scale is fitted to the end of the case to improve visibility, when used as a car radio.

The manufacturers have designed a cradle intended to hold the receiver in position below the edge of the car dashboard. A special locking mechanism renders the set virtually thief-proof.

These views show the new set used as a portable (above) or as a car radio (at left). The bank of solar cells are visible on the top of the case. Note the two dial scales, one for viewing as a portable, the other to be visible below the edge of the dashboard, when mounted in a car.

☆

The line-up is as follows: An OC170 is a self-oscillating mixer, followed by two IF stages using OC169's. An OA79 detector then feeds to an audio section comprising two OC71's and a pair of OC74 output transistors. Jacks are provided for pickup and external speaker.

Solar power for the set is obtained from twelve tiny silicon solar cells, manufactured by the semiconductor division of Hoffman Electronics Corp., of Illinois, U.S.A. Each cell measures only 1cm x 2cm, but has an output of about 500 millivolts at 30 milliamps. in bright sunlight. Connected in series, they provide sufficient power to run the radio.

SILICON JUNCTION

The cells are basically a silicon p-n junction, the layer of p-type silicon being made thin enough so that light photons can reach the depletion layer of the junction.

Photon energy absorbed by the lattice frees holes and electrons. Movement of these across the junction potential barrier generates a potential difference between the p-type and n-type silicon, the p-type being positive. This potential may be used externally as a source of power.

The cells may be regarded as a development of the familiar selenium photo-cell used in many photographic exposure-meters. The silicon photocells are about five times as efficient as the selenium type, and, at present, they have been made with transduction efficiencies as high as 14 p.c. (theory would indicate figures up to 30 p.c.).

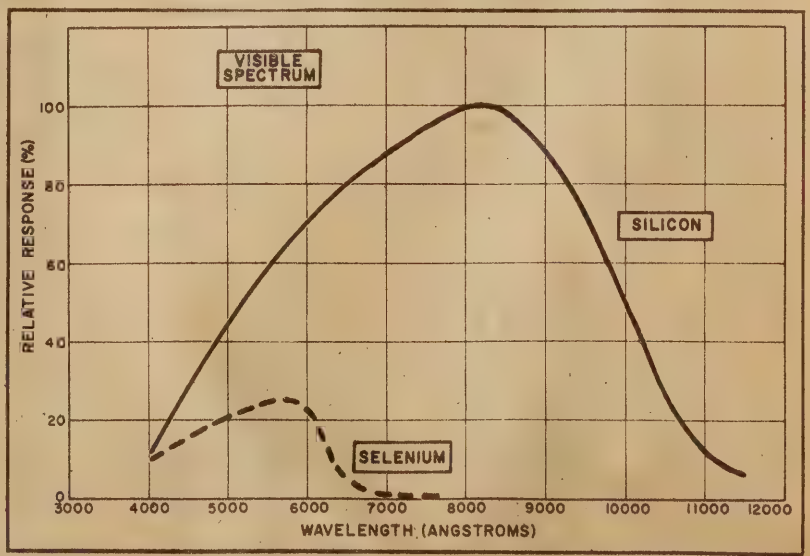
However, those available for non-military use both here and in America are not more than about 9 p.c.—still higher than the selenium type.

Due to the voltage generation mechanism, the cells tend to act as a rather poorly regulated supply. This may be embarrassing if circuits drawing a high peak current are connected to the solar battery. To counteract this, it is usual to place a large storage capacitor across the cells, which provides some storage of energy. This helps supply peak current.

This has been done in the receiver shown on these pages, because it uses a class B audio output stage. However, the source impedance of the supply from the cells is still rather high, with the result that "motor-boating" can occur at high volume levels.

The use of additional solar cells in a series-parallel configuration would probably cure this effect, but the present price of the cells would render this uneconomic.

The particular cells used in this receiver, type 120C, are only representative of the large range of silicon photo-voltaic cells made by the Hoffman Corporation.



This graph shows the spectral response and efficiency of the silicon photo-voltaic cell compared with its selenium counterpart.

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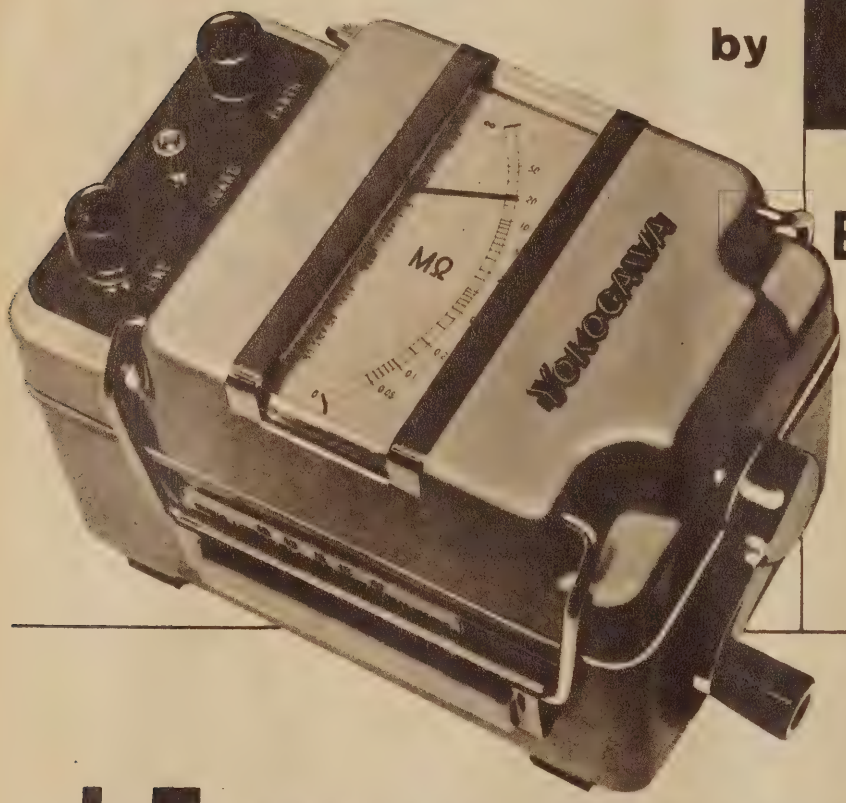

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OA-18

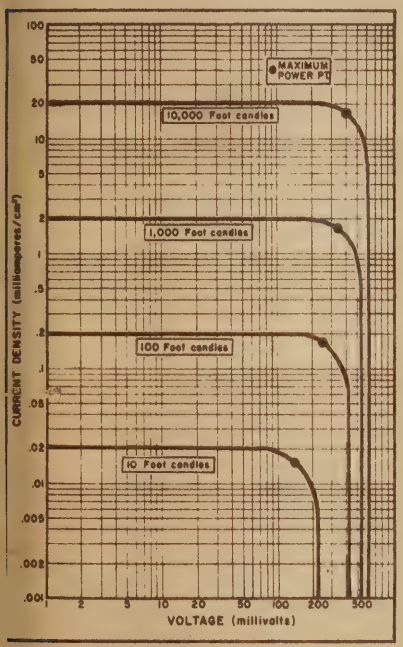
Besides seven standard silicon solar cell types, there are twelve high-efficiency types, at present only for military use.

These are the same cells used to power the electronic gear in the American space satellites, mounted on the "paddle-wheels." They have thus been through quite extensive tests for ageing and reliability.

The Hoffman Corporation also lists four types of encapsulated photo-voltaic cells, which are intended for readout use in data processing equipment and digital computors. Since they have a response speed of less than 10 microseconds, they are very suitable for these applications.

Incidentally, at least one American firm has started using these cells in the sound reproduction head of cinematograph projectors. Since they have a high output, require no power supply, and are very small, they are ideal for this application.

The manufacturer's catalogue also lists eight types of multiple readout cells.



The current-voltage characteristics for various light levels of a typical cell. The open circuit voltage is independent of cell area, varying logarithmically with illumination intensity. Short-circuit current density is directly proportional to incident light energy.

These units are intended for digital readout use, and consist of a piece of n-type silicon strip having a row of tiny p-type wafers attached to its upper surface. Thus they are basically a number of cells having a common negative connection. Types having from four to ten readout positions are listed.

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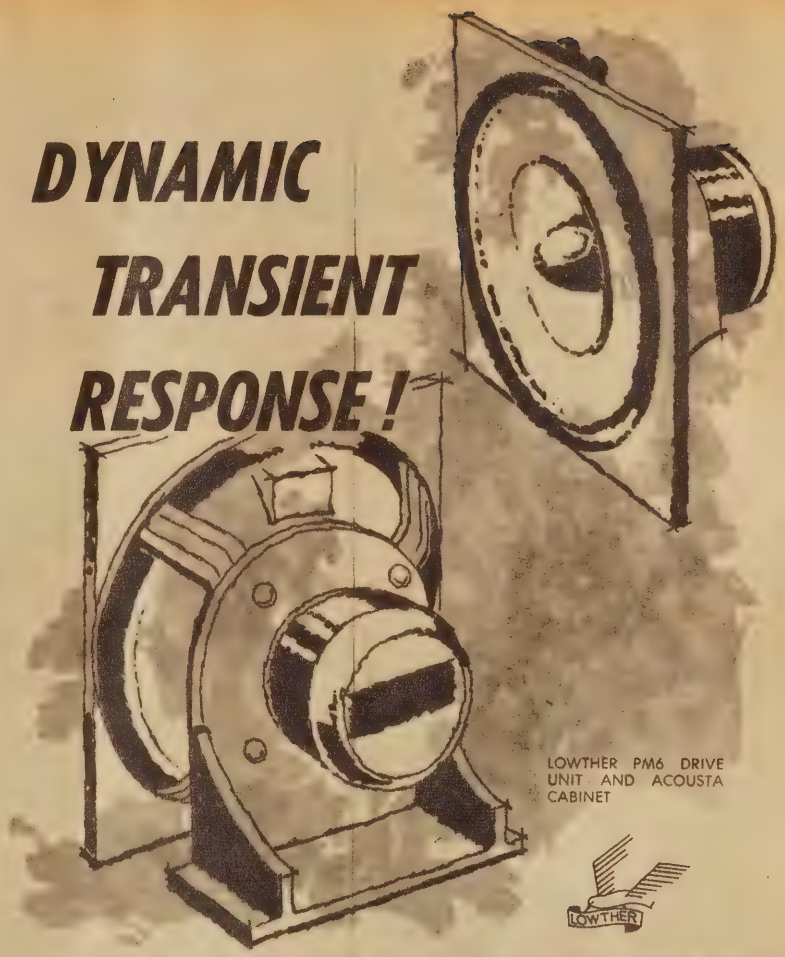

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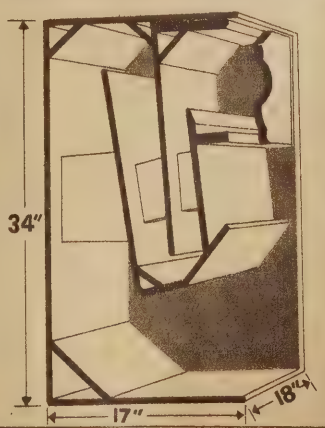

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This month we continue the discussion of the Electronic Voltmeter. Additions and modifications to the Balanced Bridge circuit are explained, including those enabling AC and resistance measurement to be performed.

By Jamieson Rowe

AS we saw last month, the basic balanced-bridge circuit has to be modified a little before it is of practical importance. As an example, consider the circuit shown in figure 1. This is the complete circuit for a simple VTVM of this type, useful for measuring DC voltages in high impedance circuits.

As before, the circuit is basically a bridge, the four bridge elements being the two triode sections of the 6SN7 valve and the two 47K resistors. A voltage is applied to the bridge from a rectifier-type power supply, replacing the battery used in the previous circuit.

The meter, a 500 microamp unit, is connected as before between the valve cathodes. However, there are two changes from the simpler circuit; one is the inclusion of a meter polarity reversing switch, and the other is the wiring of a 5000-ohm adjustable resistor in series with the meter.

The adjustable series resistance is included for the reason given last month —it allows the meter multiplying constant (used to calculate the input voltage from the meter reading, allowing for valve amplification and meter sensitivity) to be made a round number.

The reason for the meter reversing switch is not so obvious. With an instrument of this type, the chassis and case is usually earthed, for reasons of stability. If we want to measure a voltage which is polarised with its negative point earthed, all is well, since the input grid goes positive, the valve conducts more, point A goes positive with respect to B, and the meter reads.

But what if we want to measure a voltage which has its positive side earthed? The input grid will go negative, the valve will conduct less, point A will go negative with respect to B, and the meter will try to read backwards. We can't reverse the input leads to the instrument, since one is earthed, and doing so would short out the voltage under test.

Obviously, we must reverse the polarity somewhere else. One way is to put a reversing switch on the meter, as shown in the circuit. Thus the meter connections are merely reversed, allowing it to read normally.

TO SECOND GRID

Another way is to switch the input signal on to the gird of the second valve and thus in effect turn the whole bridge around. In other words, the input is applied to pin 1 of the 6SN7, instead of pin 4. This time pin 4 is placed at the earth potential instead of pin 1. With the input, point B goes negative with respect to point A, and the meter reads normally.

These are the two most popular methods for polarity reversal. They both have merit, since the bridge operating conditions are the same in both cases. However, as we shall see later on, the grid switching method lends itself a little better to combination with circuits for AC and resistance measurement. It is thus more popular in elaborate instruments.

The next modification which you may have noticed is the 5000-ohm potentiometer marked "Zero Set," connected across the plates of the two valves. This, as is apparent from the circuit, shifts the exact "top" of the bridge so that it is nearer to one valve plate than the other (or, if you like, it varies the resistances in the two top arms of the bridge).

This is done because the two valves are never exactly the same, and have slightly different characteristics (even the two halves of a double triode). Thus, for the same plate voltage and grid voltage the two currents drawn tend to be slightly different. In other words, for zero input, the bridge is still usually a little unbalanced, and the meter reads.

By adjusting the 5K potentiometers, we can vary the resistance in series with each valve in the top arms, and thus accurately balance the bridge, compensating for the valve inequalities. For instance, if valve A draws more current or no input than valve B, it has an effectively lower resistance; we can thus balance by sliding the potentiometer arm to the right.

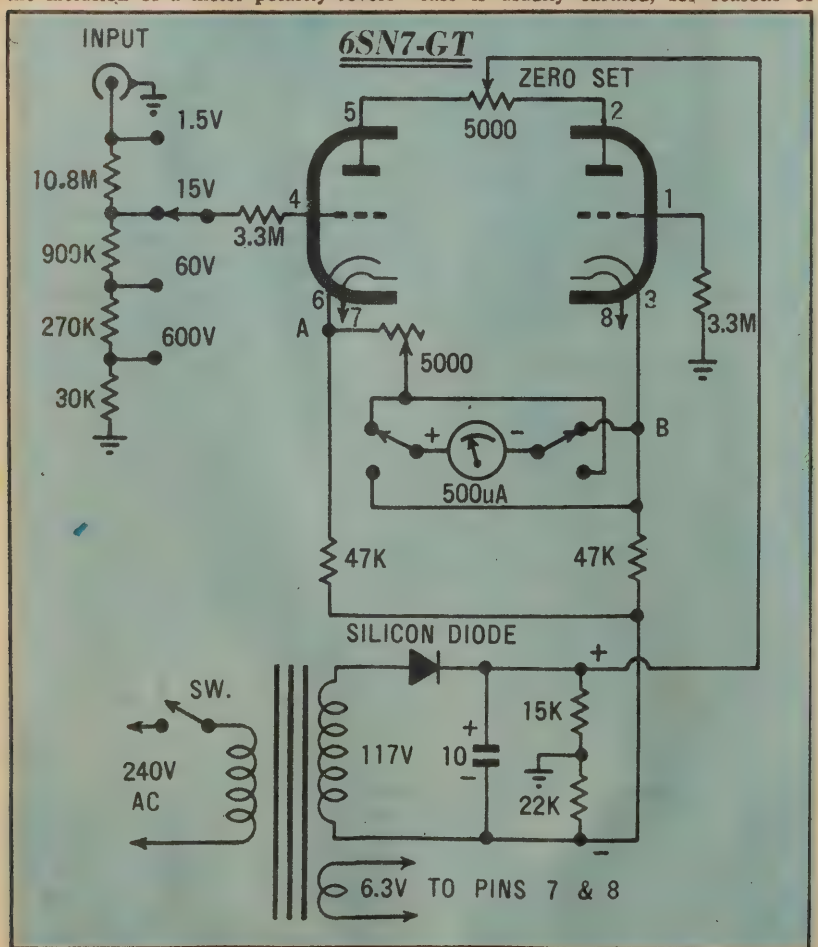

Fig. 1. The circuit for a simple balanced-bridge electronic voltmeter, suitable for high impedance voltage measurement. Useful in radio servicing for measuring grid bias and AVC voltages.

By enabling us to balance the bridge for no input, and thus make zero on the meter correspond to zero input, the "Zero Set" adjustment allows us to use the whole of the meter scale. It also means that we can compensate for any valve differences or variations.

The 3.3 megohm series resistor in series with each grid must now claim our attention. Practical valves cannot be made with a perfect vacuum inside them, with the result that there are a few gas molecules inside the best of valves.

Due to collisions between these gas molecules and the free electrons in the valve, some of these molecules lose one or more electrons, becoming gas ions having a positive charge.

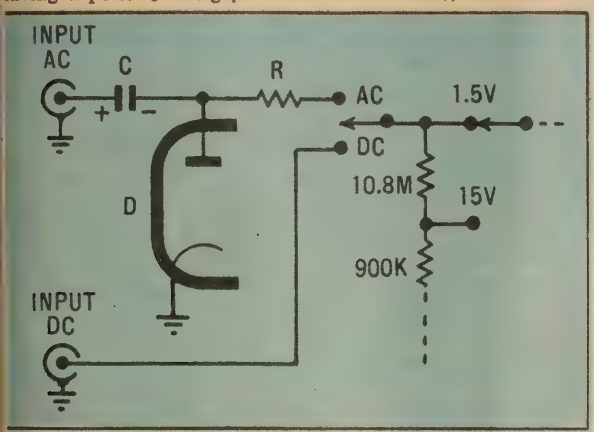

Fig. 2. By the addition of a capacitor, a diode and a resistor, the circuit shown in Figure 1 can be used to measure alternating voltages.

The grid being usually the most negative electrode in the valve, the ions collect around it. The grid can supply electrons to these ions (if there is a finite value of grid circuit resistance) and so we find electrons flowing from bias supply to grid, so that the grid can give the ions the electrons they need to become uncharged molecules once again.

This flow of electrons in the grid circuit is called "gas current." Due to the flow of this current through the grid resistance, there is a voltage drop in the resistance and the actual bias on the valve alters. Naturally, the actual bias on the valve depends on the fixed bias supply, but it also depends on the gas current, and thus the grid circuit resistance.

Thus if we vary the grid circuit resistance of the valve, the bias at the grid alters, and the operating point of the valve shifts.

This state of affairs is embarrassing in our balanced bridge circuit, since any alteration we make in the grid circuit resistance would upset the balance of the bridge.

GRID RESISTOR

This explains the reason for the 3.3 megohm resistor in each grid lead — to help swamp out changes in the grid circuit resistance. The large value reduces the ratio of change in the grid circuit resistance, thus stabilising the operating point against gas current effects. It does not affect normal operation of the valve, because the grid draws no current for its normal control function.

The input circuitry has also been modified from the simple version given last month. Instead of going direct to the grid, the input is now applied to the top of a voltage divider. The grid is moved by a switch up and down the divider, to give various division ratios. Thus at the top of the divider the grid receives the full input voltage, while at the lower points it receives one tenth, one fourtieth, and one four-hundredth (respectively) of the input.

This means that if the 5K meter sensitivity adjustment potentiometer is set so that 1.5 volts on the input grid produces full-scale deflection, the sensitivity for the four ranges is 1.5 volts (no division), 15 volts (divided by 10), 60 volts (divided by 40), and 600 volts (divided by 400).

Since the voltage divider ensures that the voltage on the grid never exceeds 1.5 volts (for meter readings full-scale or less), the valve is never driven either to cut-off or grid current due to positive grid. Thus the swing in grid voltage is low, ensuring good linearity. The input voltage divider allows us to measure quite high voltages, by dividing them down to a magnitude suitable for application to the input grid.

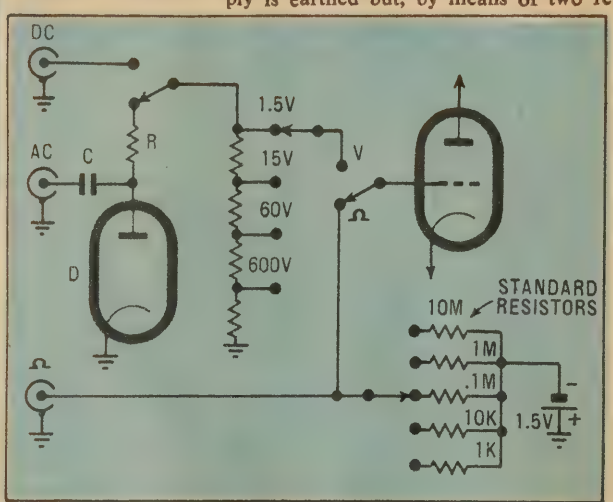

Fig. 3. A further modification of the input circuitry adapts the circuit for resistance measurement.

STILL LOADS CIRCUIT?

You may say—"That's all very well, but the advantage of the valve voltmeter was supposed to be its very high input resistance, so that it does not load the circuit under test. The resistors of the divider will lower the input resistance, won't they?"

This is quite true, they do. In practice, however, the resistors of the divider can be made quite high in value (remember: it is only the ratio of their values which matters), making the input resistance high enough for most purposes. For instance, the input resistance for the circuit shown is approximately 11 megohms, which is a fairly standard value.

But why not double or treble the resistor values, raising the input resistance to the point where it would become quite negligible?

Unfortunately, Tom, there are several catches to the simple plan. Firstly, very large values of resistor are likely to be less stable than smaller values and more easily affected by moisture, etc. Therefore, accuracy may suffer.

Again, there is likely to be a greater change in grid circuit resistance as ranges are switched or as the test prod is touched on to external circuits which themselves constitute a parallel DC path. The gas current will therefore cause more serious changes in bridge balance and, again, loss of accuracy.

CATHODE FOLLOWER

Actually, there is a very effective way we can prevent gas current from upsetting things. This is to feed the input into the grid of a valve which has a large resistor in its cathode circuit (called a "starved" cathode follower) and take the signal for the actual bridge valve from the cathode of the first valve. The starving of the first valve reduces its gas current considerably while still retaining high input impedance.

Finally, a note about the power supply. As you may have noticed, neither the positive nor the negative side of the supply is earthed but, by means of two resistors, a point somewhere between them is connected to earth. This is done to ensure that the quiescent operating point of the two valves is somewhere in the middle of their range, ensuring good linearity.

By placing the chassis, and therefore the grids, at a point about midway up the applied voltage, the voltage drop across the 47K resistor in each cathode lead is cancelled so that the cathodes are only slightly above the grids in potential. The valves thus operate at a suitable point in their range.

FEEDBACK ACTION

It's a sort of feedback action. Say the valves are drawing only a little current; the voltage drop across the cathode resistors will then be much smaller than the voltage across the 15K resistor in the grid voltage divider, and the valves will experience a positive grid voltage. This will cause them to conduct heavily, increasing the voltage drop in their cathode resistors until the two voltages cancel. Things will thus reach an equilibrium at some suitable spot on the valve operating range.

Now let us consider how this basic circuit can be adapted to measure AC and resistance. We will discuss the measurement of AC voltages first.

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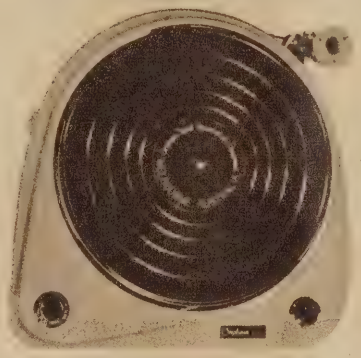

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Figure 2 shows the basic modification o the input circuit of the bridge, as incorporated in many VTVMs on the AC anges. As you can see, it involves the se of a shunt diode, a capacitor and resistor.

An alternating voltage is one which reverses its polarity periodically. One cycle of the alternation is a complete rain of events, and involves, as such, wo reversals of polarity. The part of he cycle when the voltage is positive is aid to be the positive half cycle, and he part of the cycle when the voltage is negative is called the negative half cycle (strictly, this only applies to symmetrical waves, but these are the usual kind).

In operation, the circuit is similar to a diode detector. The diode conducts on he peak of the positive half cycles of he input wave and the capacitor C harges up with the polarity as shown. This "stored" charge is really the voltge which is measured by the bridge ircuit. In other words, we measure AC y turning it into DC.

CAPACITOR CHARGED

If the circuit is arranged so that the apacitor C stays charged in operation, he net voltage applied across the circuit resistance is equal to the capacitor oltage, which is the peak value of the nput wave. The full alternating comonent of the input wave is also present, ut this has no effect. Even if this "AC" component does reach the bridge, the ositive and negative half cycles cancel ne another without deflecting the meter.

During the peak of the positive half cycle of the input wave, the capacitor C harges up through the conducting diode, s we said before. The capacitor voltage uilt up by the charge adds to the input oltage during the negative half cycles. Thus, because the capacitor aids the inut during the negative half cycles, approximately twice the current due to the nput voltage alone flows over this part f the cycle. As far as the input circuit s concerned, this amounts to a lowering f the meter input impedance.

The positive half cycles of the signal lso see a reduced input impedance, particularly near the peaks, when the capacitor is charging up. So, as you may ather, the input impedance is neither onstant nor easy to calculate.

To keep the input impedance reasonbly high, the circuit resistance (consisting of R in series with the input voltge divider) is made large, which increases the time needed for the capacitor o discharge.

TWO ROLES

The resistor R has two purposes. One is to act as the top resistor in a voltage ivider, the other component being the ormal DC divider string. Its size can e fixed so that it brings the voltage own to 0.707 of the peak value of the lternating wave, known as the Root-ean Square value, useful when comaring alternating and direct voltages.

The other purpose is to isolate any ray capacitance, which may be present the divider network from the input rcuit. If this were not done, the stray apacitance would increase the input apacitance of the circuit at high frequencies. This is particularly necessary the capacitor and diode are put in a robe at the end of a cable in order to cut down lead inductance. In such cases a resistor R is included in the probe to isolate cable capacitance from the diode circuit.

(Note: High resistance circuits with diodes, such as the one discussed, are complicated by the effect known as "contact potential." This is a small negative potential which appears on the plate of the diode due to its being in the space charge of the cathode.. To stop it unbalancing the bridge, a second diode is usually connected to the other valve grid, balancing it out.)

TO MEASURE RESISTANCE

As we mentioned before, the valve voltmeter (VTVM) can be used to measure resistance quite easily. Figure 3 shows the basic circuit used with the balanced bridge type meter.

As you might guess from the circuit, the idea is to use the unknown resistance as part of a voltage divider across the 1.5 volt battery. For instance, if the input resistance is infinite, the meter will read 1.5 volts. If the unknown resistor is equal in value to whichever standard resistor is placed in series with the battery, the meter will read half of 1.5 volts or 0.75 volts. So we can calibrate the meter scale in terms of the unknown resistance. Various resistance ranges are provided by altering the standard resistors.

We seem to have used up all the available space this month, Tom, so it looks as if we will have to leave the amplifier type AC VTVM and the automatic electronic voltmeter until next month.

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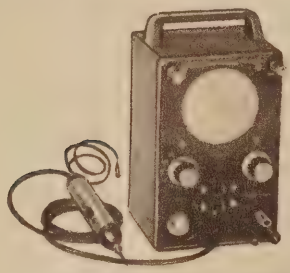

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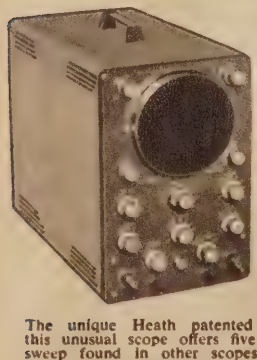

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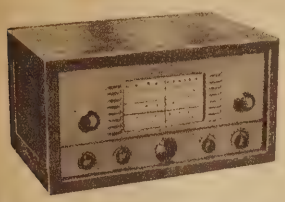

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DESIGN FOR A VALVE TESTER

In recent weeks, our laboratory staff has been working on the design of a combined valve and transistor tester, intended for home construction and suitable for use by radio servicemen—or by anybody else, for that matter, who has need for such an instrument. This preliminary article discusses the general subject of valve testing and clears the way for the constructional article to follow.

By Alan Nutt

NEXT to the conventional multimeter, one of the most useful pieces of test equipment in the service workshop is a valve tester.

Although an experienced serviceman may be able to locate the most obscure faults without the aid of even a multimeter, the task is inevitably simplified and speeded up by the availability of suitable test equipment.

Some valve troubles, such as loss of vacuum or gas, are obvious in their effects and the results visible on inspection of the offending valve. Other faults, unfortunately, are not at all obvious on inspection, and their presence can only be guessed at by the nature of the fault they produce in the equipment under test.

In such cases it is logical to turn to the valve tester and to put suspect valves through their paces, as it were, in order to determine the nature of the fault and thereby confirm the diagnosis.

In order to investigate fully all the characteristics of a particular valve, quite a large number of tests must be carried out. These tests, while for the most part not requiring over-elaborate instruments, nevertheless can be very time-consuming, if only by reason of the fact that the setting up of each individual test, its operation and the subsequent interpretation of the results can be quite an involved process.

Only in a valve application and development laboratory is a valve normally subjected to a full range of tests that will indicate its condition in detail. Servicemen normally have to be content with a few relatively simple tests that will show up the more obvious faults, and thus indicate whether the valve should or should not be replaced.

A full range of tests will include a check for element shorts and continuity, heater continuity, heater-cathode leakage, noise and microphony, mutual conductance, emission, reverse grid current, power output, distortion and certain other specific tests, depending on the type of valve—i.e., amplifier, converter or rectifier.

It may be well to consider in some detail these tests and from them determine those most likely to meet the need of both serviceman and experimenter.

INTERNAL SHORTS are fairly common in ordinary receiving valves. In general, they cause complete failure in operation and necessitate immediate replacement. A test for shorts is important in that, being normally the first test applied to a valve, it will indicate the presence of a short that could otherwise cause damage to the sensitive instruments used in later tests.

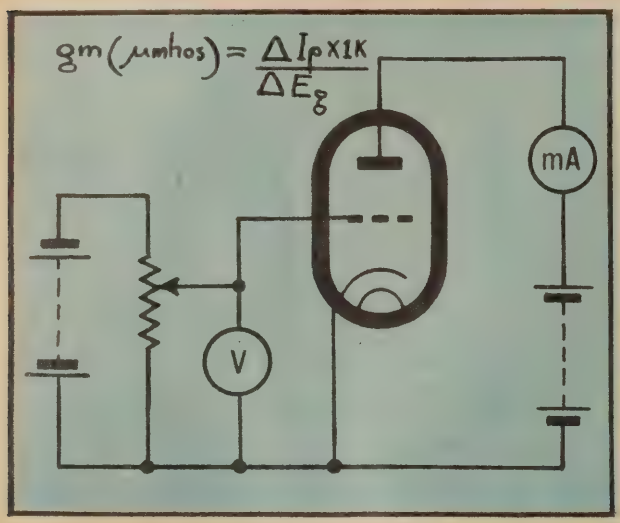

Figure 1. Measuring transconductance. Note that the published value of transconductance can only be expected if the plate current is preset to the equivalent published value. The grid voltage should also be shifted by equal increments either side of the standing bias.

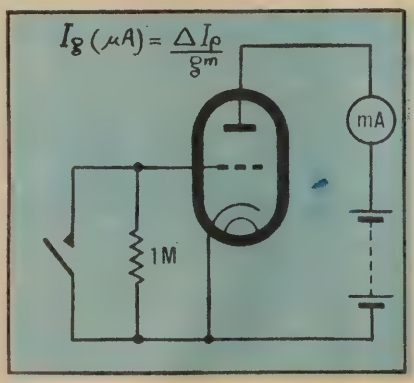

Figure 2: Measuring grid current: After setting the plate current to a suitable value, the switch is closed and the variation in plate current noted, being a measure of the voltage developed by grid current across the 1-megohm resistor.

A test for OPEN CIRCUITED ELEMENTS may be provided in conjunction with a shorts test, and, although open circuits are not common, they can be very difficult to locate if they occur. The results of such a test can be misleading however, unless special precautions are taken, and we will say more of this when discussing the shorts test in detail.

HEATER CONTINUITY may likewise be included in a shorts test, the indicator being so arranged that it will operate if the heater or filament is in contact.

HEATER-CATHODE LEAKAGE is important in valves designed for use in high gain, low level amplifier stages. Even the presence of relatively small leakage currents can cause hum voltages to be imposed on the signal voltage, and be amplified along with the desired signal.

TOLERANCE NECESSARY

Some tolerance is necessary, however, and a leakage test is normally carried out with 100 volts applied between heater and cathode. Leakage currents in the order of 20 to 50 microamps is common for valves having a 6.3 volt .3 amp heater. In power valves the leakage current may be as high as 100 microamps, without appreciably affecting the operation of the circuit.

While some of the more complex instruments have provision for NOISE and MICROPHONY tests, the additional expense and complexity is hardly warranted. The most practical test from the serviceman's point of view is a check of the valve in its actual operating position in a receiver or amplifier.

While it may be possible to use a particular valve in a high level amplifier stage with no trace of either noise or microphony, the same valve may prove useless when transferred to a low level pre-amp. stage. The microphony and audio noise of a valve, therefore, are largely dependant on the position that it occupies in the set and each case must be considered on its own merits.

A further test can be carried out to determine the RF and THERMAL NOISE of a valve, but these tests are necessarily more complex and have little value for the ordinary serviceman, being more applicable to the design rather than the servicing of equipment.

The MUTUAL CONDUCTANCE or TRANSCONDUCTANCE, particularly

under maximum rated operating conditions, is probably the most important single characteristic of a valve, since upon it depends both stage gain and power output in a receiver or amplifier.

A satisfactory mutual conductance reading will indicate more conclusively than any other test that all the elements in the valve are operating normally.

Even so, the indications of a mutual conductance test cannot be regarded as infallible and there may be occasions on which the readings of a mutual conductance test may fail to agree with actual results in a receiver or amplifier.

The mutual conductance of a valve is usually defined as the ratio of a small change in plate current to the small change in grid voltage which produces it, **all other voltages remaining constant.** This latter requirement is the most difficult to meet in a simple instrument and normally requires the use of regulated power supplies if the results are to be interpreted accurately.

MUTUAL CONDUCTANCE

This ratio is actually the slope of the plate current-grid voltage characteristic of the valve and may be expressed in terms of so many milliamps per volt (e.g., 1.5mA/V.).

Mutual conductance may also be expressed in terms of "conductance," measured in mhos. A more practical unit is the "micromho," which may then be defined as the ratio of the change in plate microamps to the change in grid volts.

To convert slope in mA/V to mutual conductance in micromhos it is necessary only to multiply the slope figure by 1,000. For instance, 1.5 mA/V is equal to 1,500 micromhos.

Since the performance of a valve is governed largely by the mutual conductance, and since the mutual conductance is one of the published characteristics of all amplier valves, it follows that the performance of a valve may be determined by the measurement of this property, the value of which may be quickly checked by reference to any valve data book.

It must be borne in mind, however, that the mutual conductance of a valve is not a constant figure but varies considerably with different operating conditions. However, it is reasonably constant for any given value of plate current.

OPERATING VOLTAGES

It is logical to assume, therefore, that in a practical tester circuit it is not strictly necessary to duplicate the exact operating potentials, except where extreme accuracy is desired, provided the required value of plate current can be secured.

The actual test is carried out by first adjusting the various operating voltages on the valve elements so that the required value of plate current is duplicated. The grid voltage is then shifted equal amounts, usually plus or minus half a volt, either side of the standing bias voltage and the change in plate current noted. The mutual conductance is then equal to the plate current shift in milliamps divided by the grid voltage shift in volts.

The EMISSION of a valve is a very important characteristic which provides a useful basis of operation for the simpler types of valve tester.

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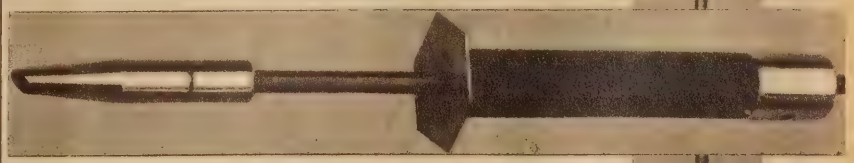

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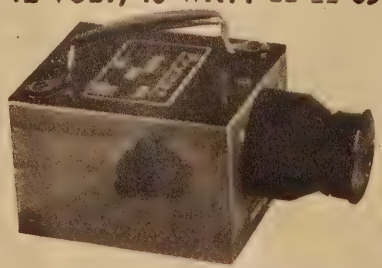

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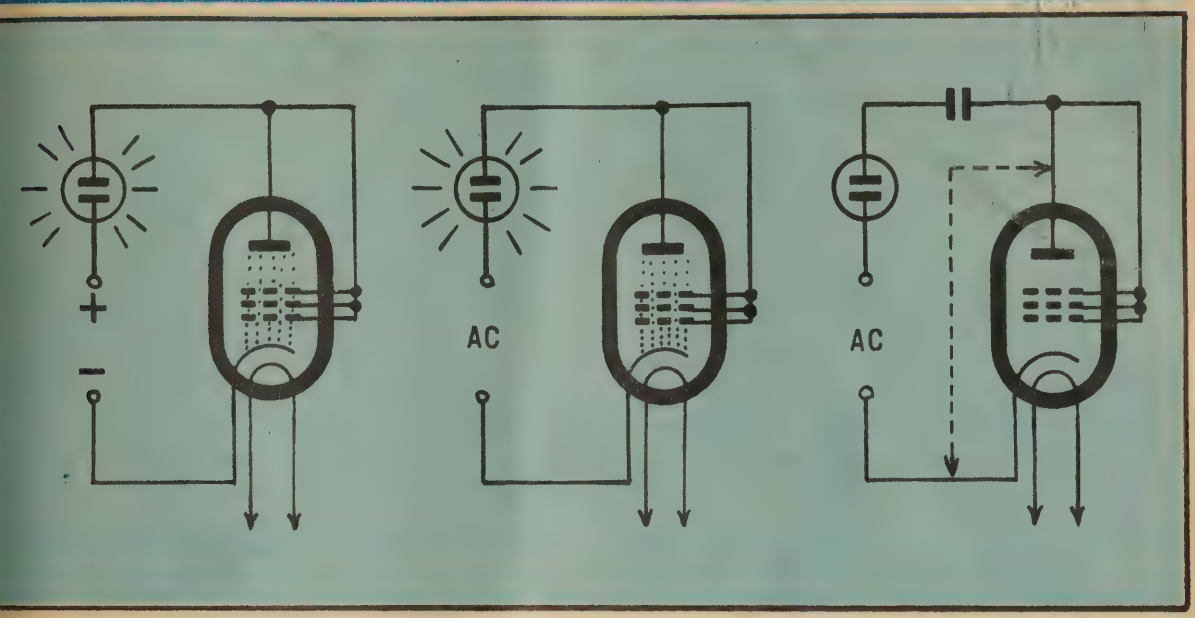

Figure 3. Testing for element shorts: In (a) and (b) the neon lamp will light due to cathode emission regardless of whether the applied voltage is AC or DC. The addition of a blocking capacitor (c) effectively prevents ignition of the lamp unless a direct short exists between the cathode and some other element.

on exceeds a certain minimum, al-ough some valves exceed this value by greater margin than others. As the nission falls below this level, the char-teristics of the valve can change ap-eciably, usually resulting in reduced utual conductance with consequent loss gain and power output.

On the other hand, emission in excess the required minimum will not aterially affect the characteristics nor dicate that the valve is better than erage in service.

MISSION TESTS

Emission tests taken with cathode cur-nts approximating those encountered in tual service are not true emission tests, it are really a measure of the "internal ode impedance." As such, the readings e affected by the internal structure of e valve and under a given set of con-tions may vary up to 25 per cent be-een similar valves of different manu-cture.

In a simple valve tester, this is nor-ally the type of emission test employed id the abovementioned discrepancies ake it impossible and misleading to curately calibrate the quality meter and e scale should preferably be marked Good-Doubtful-Bad" without any fur-er sub-division.

When a valve reads "Good" it should regarded as satisfactory and no un-cessary speculation should be made as the degree of "goodness." It is cely to be assumed that, when the inter travels right across the scale, e valve under test is very good but at if it only travels nine-tenths of the stance the valve is not so good.

Actually, in both cases, the emission ould be well above the necessary mini-um value and the properties of the lves otherwise identical.

There are several reasons for the pre-nce of GRID CURRENT in a valve, e most common being the presence of s within the valve envelope. In ex-treme cases, this gas will be plainly vis-ible as a bluish glow within the valve elements. This glow should not be con-fused with the blue fluorescence that sometimes occurs inside the glass en-velope and usually varies in intensity with the applied signal. This latter effect is indicative of a high vacuum within the valve.

CONTACT POTENTIAL is a further reason for the presence of grid current and it is very difficult to minimise its effects. By special design and choice of materials it is possible in manufacture to keep it to quite a low level. Very often the grid material itself will emit electrons due to impurities in the material reacting as the valve becomes heated and, again, a strict control on materials used in manufacture is re-quired to keep this effect to a minimum.

OVERLOAD CONDITIONS

Under overload conditions, gas may be liberated from the grid wire material and the valve is then said to be "soft." The cathode surface is usually destroyed and its electron emitting property ceases, or is greatly reduced.

A test for REVERSE GRID CUR-RENT may take two forms. Either the current may be measured directly with the aid of a very sensitive microam-meter in the grid circuit or it may be calculated indirectly in the following manner:

The valve is operated under normal conditions but with a 1 megohm resistor in the grid circuit which may be shorted out. In the presence of grid current, short circuiting the grid resistor alters the grid voltage and hence the plate cur-rent.

The grid current in microamps is then approximately equal to the change of plate current in milliamps divided by the mutual conductance (or slope) of the valve in mA/V. This latter figure may be obtained from a valve data book and will be accurate providing the initial plate current is set at the value given in the data book.

Some small amount of grid current will always be present but for ordinary receiving type valves the value should not exceed about 1 microamp. For power output valves, the grid current may be as high as 5 microamps.

The more specific tests are applied to the valves depending on their particular function. Amplifier valves are tested for plate resistance, amplification factor, elec-trode dissipation and distortion. In addi-tion, converter valves are checked for conversion conductance, oscillator trans-conductance and grid blocking. Recti-fiers are subjected to tests to determine their rectification efficiency, arcing effects and back emission.

These latter tests, however, while im-portant in valve manufacture and design, are of no particular importance to the serviceman who is more concerned with a simple test that will indicate with rea-sonable accuracy whether a valve is simply "good" or "bad" and should be replaced.

We may conclude then, from the fore-going that the essential tests are firstly a short circuit check, either a mutual conductance or emission test and possibly a gas or grid current test.

"SHORTS" TEST

Short circuits: In a practical instru-ment, a short circuit element check is best accomplished by applying a simple continuity test between individual pairs of elements or between each individual element in turn and the remainder con-nected together.

Permanent internal shorts may be located with a pair of test prods and a sensitive continuity indicator, either a lamp or meter movement. Such an arrangement, however, is rather tedious, particularly with multi-element valves.

In all instances of tests for short cir-cuits, it is a wise procedure to tap the valve gently under test either with the

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and or some form of rubber mallet. The reason for this is obvious in that many shorts are of an intermittent nature and will only be revealed when the valve is subjected to a slight shock.

Care must be exercised, however, as too severe a shock may fracture the envelope or knock off the exhaust tip on the smaller all-glass types.

The provision of a continuity check may, at first glance, seem a relatively simple requirement to meet. However, there are one or two difficulties that arise in practice and it is well to consider them before making any attempt at the design of such a circuit.

LEAKAGE TESTS

For normal service work, there is no need to determine the exact amount of leakage in a particular valve and a simple neon bulb will perform satisfactorily as an indicator. In more complex equipment, leakage may be measured accurately by means of a meter but, in our case, we are only interested in locating direct shorts, either of a permanent or intermittent nature.

Firstly, it has to be decided whether to use AC or DC as the test voltage. If we decide to use a DC supply, emission from the hot cathode surface is likely to cause a false indication of leakage by reason of the current flow between the cathode and the other element under test.

Even if the polarity of the applied voltage is adjusted so that the cathode is positive with respect to the other element, one test position will always be found in which this condition is reversed and a false leakage indication again results.

One solution to this difficulty is to remove the filament or heater voltage during the shorts test. Although this will eliminate the trouble caused by cathode emission, it does not make provision for the intermittent shorts that only show up when the valve has reached its normal operating temperature.

AC SUPPLY

Heater-cathode shorts are notorious in this respect, often developing only after a period of time has elapsed after switching on.

The logical solution would seem to be an AC supply instead of a DC supply, but here again we find ourselves in difficulties.

In nearly every test position the cathode will be one of the elements under test, whether it is picked out from the remainder or connected with the remainder. This being the case, the valve will function as a simple half-wave rectifier, passing current every half cycle of the applied voltage. This will again lead to a false leakage indication and brings us seemingly back to where we started.

The problem may be solved at this point by the addition of a series blocking capacitor into the circuit. This capacitor will prevent the continuous flow of current every half-cycle through the valve in the following manner:

The first half-cycle of current through the valve will charge the capacitor to approximately the peak value of the available voltage. Once fully charged, it is not possible for any further current to flow into the capacitor unless, first of all, some discharge takes place.

The capacitor is prevented from discharging, however, by the diode action of the valve which stops any reverse flow of current from the capacitor back into the circuit.

The only current flow, therefore, is the initial charge pulse into the capacitor, which will be indicated by a brief flash in the neon bulb. The effect of cathode emission is thereby very effectively eliminated.

On the other hand, if the valve has an internal short between any elements, its effect as a rectifier ceases and an AC current will flow through the capacitor, which now appears only as an impedance in series with the neon lamp across the AC supply. This current will energise the lamp, indicating the presence of the internal short circuit.

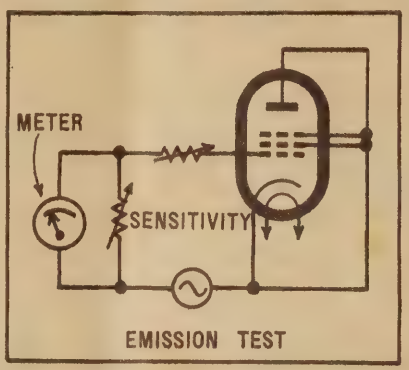

Fig. 4. The basic circuit for an emission test is quite simple, the main requirement being the calibration of the sensitivity control.

The capacitor used in this position should have low self-leakage, as even a value of several megohms will be sufficient to light the neon, due to cathode emission current.

Due to dust or moisture on the valve base or socket, very small leakage currents may cause the neon to flicker excessively. This may be overcome by reducing the sensitivity of the indicator to the point where a leakage in excess of two or three megohms will not give any visible indication.

By a suitable choice of series capacitor, the sensitivity of the indicator may be reduced to the required level. A shunt resistor across the lamp is also sometimes employed for the same reason.

OPEN CIRCUITS: By removing the series capacitor from the circuit, the effect of the cathode emission current can be used to check for open circuit elements.

LIMITATIONS

The cathode is retained as the common element, and each of the other elements is paired with it in turn, while the AC source voltage is applied. If no open circuit exists, the neon lamp will glow, due to the cathode emission, as mentioned previously, and this may be taken as a good indication of element continuity.

This method has limitations, however, in that elements some distance from the cathode, such as screen and suppressor grids, may not have sufficient current flowing to them to give an indication on the lamp, thereby leading to the false conclusion that the particular element is open circuit.

QUALITY TEST: Although the general consensus of opinion favours a mutual conductance test in preference

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an emission test, in that it gives a ore complete picture of a valve's per- rmance, the usefulness of a simple nission test cannot be lightly passed ver.

While it is true that a mutual con- uctance test may be more valuable in etermining the actual working con- tion of a valve, an emission test can e almost as useful and a good deal mpler to carry out. Apart from this, e additional circuitry required to carry it an accurate mutual conductance test lds quite a lot to both the complexity nd cost of the instrument.

Not only must the power supply have ood regulation, as mentioned before, it as each element requires its normal erating potential, the selector switch- g and power supply are further com- icated. Further, provision must be ade for measuring both plate current nd grid voltage.

IMPLE POWER SUPPLY

An emission test, on the other hand, quires an extremely simple power sup- y and element selector switching is eatly simplified as only one element eed be picked out in order to carry out e test.

In practice, the element nearest to the thode, usually the control grid, is lected and a fixed potential applied be- veen it and the cathode. When testing odes, of course, the plate must be lected as the other element. All the her elements are either left open circuit tied to the cathode, depending on the fect they might otherwise have on the nission test.

The voltage applied across the valve normally 30 volts, either AC or DC, e valve acting as a self-rectifier in the ent of AC being used. A sensitive eter then measures the current flow rough the valve, indicating on the ale whether the available emission is ove or below normal.

The emission current varies widely be- veen valves of different types, small bat- y type valves naturally having much ss emission than, for instance, a power tput valve or rectifier. In order to ake allowance for this, a coarse sen- ivity adjustment is usually provided by eans of fixed resistors switched in series th the meter, the value depending on e type of valve being tested.

ATTERY VALVES

For battery valves and other valves of nited emission, the series resistor is 00 ohms. All other types, with the ception of power output valves and rec- iers, use 1000 ohms. These latter types ploy a 200-ohm resistor.

A fine sensitivity adjustment is obtain- by means of a low resistance poten- meter connected across the meter and ing as an adjustable shunt. The coarse justment is pre-set according to the e of valve being tested and the fine trol is then set for each individual e. In the calibration of the instrument setting is logged for this control for h type of valve that it is desired to t.

When carrying out the test, it is im- tant that the duration of the check not longer than about three seconds it is possible for the grid dissipation ing to be exceeded in some circum- nces.

A test button may be provided that l enable the controls to be set up or to testing and then pressed for the ual test. It is important to notice if the emission ops off rapidly during the three second duration, as this will be indicative of ss of peak emission.

A good valvewill indicate a steady emission currenor one that falls very slowly. At theend of three seconds, however, the edle should still be within the "God" section of the scale.

Heater voltas: In providing the necessary filamet or heater voltage for a seemingly infite variety of valves, we are faced with te problem of just what ranges will be nade available, so that the tester may e as universal in its application as posble.

While there æ certain accepted "standard" heater and filament voltages, the decision is complicated by the seemingly infinite variety of voltages in valves designed specifically for series heater operation in AC/DC equipment.

In use at the present time are valves whose filament or heater voltage varies between 0.6 volts and 117 volts. To supply every possible value within this range would require a transformer with an almost impossible number of taps, as well as a number of rotary switches for selection of the desired voltage.

Even if it was decided to make provision for all the existing types, the limiting factor would be the number of switch

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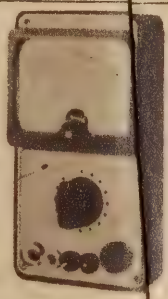


TESTER BOY MULTIMETER

The Tester Boy Multimeter is ideal as a portable instrument for the hobbyist, motor mechanic, etc.

Dimensions are—6in high, 2½in wide, 3½in deep. Weight 1lb 13oz.

Ranges as follows:—Volts AC and DC 2.5, 10, 50, 250, 500, 5,000.

Resistance 0-10,000 ohms, 0-100,000 ohms and 0-1 meg. ohm.

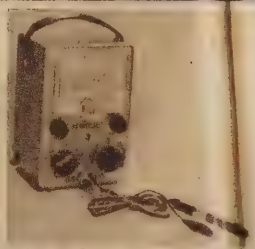
D.C. Current—0-1, 10, 500mA.

Decibels minus 20 db to plus 9 db, to plus 22 db.

By referring to a chart up to plus 56 db may be measured.

The case is black bakelite with metal panel 3in meter. Test leads are provided and also a leather carrying case. Sensitivity of meter is 1,000 ohms per volt.

Price of this unit is £9/10/-



FERROCART VACUUM TUBE VOLTMETER

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Size of Meter: 3½ inches.

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Weight: 23ozs.

Ranges are as follows:—

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PL12	7 inch	1200ft	35/-
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8. **TE106 PENCIL TESTER.** This meter is only the size of a fountain pen, clips into pocket and is ideal for serviceman or experimenter. Ranges are as follows. AC and DC Volts 0-12, 0-300, 0-600, Ohms 0-50,000. Supplied complete with test prods. Price reduced from £3/10/- to £2/10/-.

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sitions available. While it is possible use two or more switches, too many itch positions and too many taps on e transformer make it an expensive oposition, particularly for the home nstructor.

After giving the matter a great deal of ought, the idea of providing a "pre-rred range" of filament voltages was rived as a likely—and apparently ori-nal—solution to the problem.

REFERRED RANGE

This preferred range would function in similar manner to the preferred ranges both resistors and capacitors, where-, by reason of the normal tolerance read of plus or minus 10 per cent, it possible for a certain value of com-nent to cover both values above and low its nominal value.

It is then possible to manufacture a finite number of components with minal values that will effectively cover l values likely to be encountered in actice within a given range.

On further investigating this line of ought we found that it would be pos-le to provide a full filament voltage verage within the range previously entioned with a plus or minus toler-ce of between seven per cent and eight r cent instead of 10 per cent as origin-ly suggested, and as allowed by valve anufacturers for the heater supply.

This means, in effect, that while we ovide only a limited number of nomi-l taps on the supply transformer, by itably calibrating the filament range itch we can make these nominal volt-es cover every voltage likely to be countered in practice within the speci-d range of 0.6 volts to 117 volts.

At the same time, by limiting the lerance spread to eight per cent no lve will be tested with its filament or ater operating higher than eight per nt above normal. This is well within e ratings given in data books which ecify plus or minus 10 per cent for ost types of valves.

LAMENT VOLTAGE

As a practical example there are valves fairly common use with heater volt-es of 14V, 15V, 16V, 16.5V, 16.8V, V, 18.9V and 19V. In order to accu-tely provide the necessary filament ltages for each of these types eight itch positions and eight transformer ps would be required.

However, by providing taps for two eferred values, one of 15V and the her of 18.5V, each of the required fila-ent values is effectively covered by the lerance spread of seven or eight per nt.

One criticism that may be levelled at is idea is the change that will occur the emission characteristics if the fila-ent or heater voltage is other than the act value required for the particular lve in question. This difficulty does ist, of course, but may be quite simply lanced out in the calibration of the mpleted instrument.

Some form of reference chart is re-ired in order to pre-set the various itches on the instrument and the set-g noted for the sensitivity control can sily be adjusted to allow for the fact it the valve may have a higher or ver than normal heater voltage.

Bearing in mind the nominal value of tage available from the supply trans-mer and the particular range of volt-es that this tap is designed to cover, it not a difficult matter to calibrate the sensitivity contro so that, should the rated heater voltæ of the valve be less than the nomin value supplied, the sensitivity may t decreased slightly to offset the effectsof increased emission from the cathod

On the other hnd, if the rated heater voltage is higherhan the nominal supply voltage, then th sensitivity should be increased somewat to offset the effects of decreased emsion. More will be said about this laterin regard to the actual calibration procdure.

LINE TEST: n the particular type of instrument unde discussion the accuracy of the emissior test can be affected to quite a degree y fluctuations in the line supply voltage. These fluctuations will affect both the ilament or heater voltage and consequenty the emission as well as the voltage aplied across the valve for the actual test

LINE VOLTAGE

It is norml, therefore, to include some form o line voltage adjustment whereby the lie voltage can be corrected to some predetermined calibration mark. Provision is usually made so that the meter used fc the emission test can be made to funcion as a simple voltmeter across one c the secondary windings and the line adjustments made by suitable taps an a switch in the primary of the transformer.

In a forthcoming issue we hope to describe the construction of a typical valve tester suitable for service work and also for the home experimenter. We will also discuss some of the mechanical details, the alibration of the completed instrument as well as its use in the workshop and th interpretation of the results likely to be encountered.

The instrument we are planning incorporates, as an optional feature, the transistor tester described in our August, 1960 issue. It will therefore be a very useful item of test equipment.

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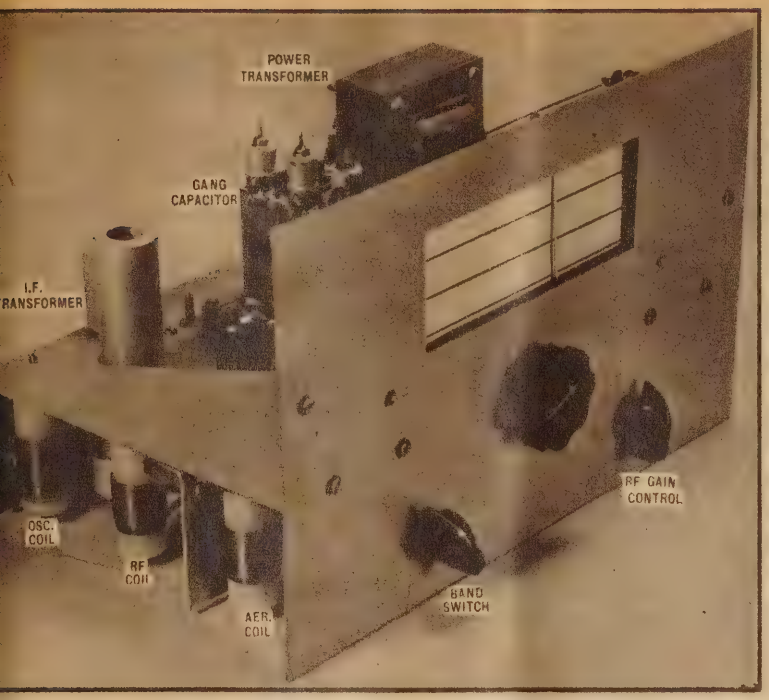

he completed converter may be housed in any suitable cabinet. When he photograph was taken the dial and panel had not been calibrated. The 40-metre coils are visible under the left-hand end of the chassis.

IF frequency away from the received signal will be more greatly attenuated. The aerial and RF tuned circuits are better able to discriminate between signals that are, say, three megacycles apart than ones that are only 910 Kcs. apart —which would be the case if a normal 455 Kc. IF channel were used.

The only problem to guard against in such an arrangement is harmonic radiation from the local oscillator in the receiver itself. Unless care is taken in the selection of the first intermediate frequency, these harmonics may be picked up at the converter input and appear as either a heavy carrier on the band or as an interfering heterodyne.

OSCILLATOR HARMONICS

We have selected 1500 Kcs. as the output frequency for our converter, firstly because it enables a normal broadcast receiver to be used as the IF channel and secondly any oscillator harmonics, which would normally be multiples of 1955 Kcs., will not fall in any of the amateur bands covered by the converter.

The circuit itself is quite conventional, the only point of interest being the method of oscillator injection. The coupling capacitor from the plate of the oscillator is connected to the cathode of the pentode section of the 6U8, the oscillator voltage being developed across the 1K cathode resistor which is unbypassed.

AN AMATEUR 3-BAND CONVERTER

Many readers may have wanted to listen in on the amateur bands, but the receiver on hand has just not had that extra "oomph" to pull in the rare DX stations that the locals have been working. Maybe the receiver does not cover the particular DX band that you are interested in.

By Alan Nutt

ERE then is a relatively simple solution to the problem—a short-wave verter designed especially for the ateur bands, which can be constructby the average home builder for a imum of outlay.

lthough not intended as an end in lf, nor even the ultimate in design, converter will give excellent results the three most popular DX amateur ds and as such will meet the needs many short-wave listeners and ateurs alike.

ILT-IN SUPPLY

Designed to feed into a standard adcast receiver, the converter features own built-in power supply and voltage ulator, which adds considerably to the bility of signals, particularly on the ner frequency bands.

For simplicity of operation, only one d is required between the converter the broadcast receiver. Controls have been kept to a minimum, conent with flexible operation.

By utilising a small value of tuning acitor and employing normal bandead technique, the coverage of each d has been designed to extend only the limits of the desired amateur ds. Tuning the converter becomes a asure with such a degree of bandead and, providing a good dial mechism is used, it is possible to tune stations with even greater ease than on the broadcast band.

The converter is, in effect, a normal superhet receiver front end, consisting of an RF amplifier and a mixer-oscillator. The main difference between a converter and a conventional front end is in the selection of the intermediate frequency.

The IF channel in a normal receiver is in the vicinity of 455 Kcs., or possibly even lower. A converter, on the other hand, uses a relatively high intermediate receiver that falls within the normal tuning range of the receiver that is to follow the converter. Converters designed for VHF operation usually have an IF in the region of 7 to 10 Mcs.

I.F. AMPLIFIER

The following receiver becomes the IF amplifier for the converter and the entire set-up functions as a double conversion superhet. The receiver, in due course, will heterodyne the converter output to its own intermediate frequency.

The advantage of the double conversion system is that, due to the relatively high first intermediate frequency employed, the image signal which is twice the

This method of injection gives very good isolation between the mixer and the oscillator and reduces any tendency for the input signal to "pull" the oscillator frequency.

The RF amplifier is a 6BY7, a variable-mu valve with similar characteristics to the 6BX6. Although no AVC is applied to the stage, a variable-mu valve was still considered the best for this position, if only to reduce the possibility of cross-modulation problems on very strong signals.

RF GAIN CONTROL

An RF gain control has also been included to take care of overload on strong local signals and also to make operation of the unit more flexible for use on CW.

Using plug-in type coils can be a time-consuming business and we decided to use a band-switching arrangement. The coils were wound on ¼in diameter polystyrene former, already grooved to the requisite 16 turns per inch. The coil formers may be purchased complete with mounting base and iron dust slug. The latter are approximately 3/8in diameter.

The tuning capacitor is a three-gang FM type and is available from Messrs Watkin Wynne. A 100 pf capacitor is placed in series with each section of the gang which limits its effective capacitance change to approximately 9 pf. This

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100,000 ohm	600 ohm
50,000 ohm	400 ohm
5,000 ohm	250 ohm
25,000 ohm	2.5 meg.
10,000 ohm	10,000 ohm
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1Q5	1/6	1T4	4/6	6AB7	6/	6AC7	
6AG5	6/9	6AJ5	9/6	6C4	5/	6C8	
6G6	12/6	6J7	4/9	6L7	12/6	6R7	
6S7S	7/6	6SH7	2/3	6SJ7	10/	6U7	
6X5	9/6	7A6	5/	7A8	5/	7C4	
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12C8	10/	12H6	7/6	71A	10/	217C	15
328A	2/6	803	30/	807	11/6	809	1
815	29/6	830B	10/	832A	35/	954	
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will allow each band to be covered in the full sweep of the capacitor with a small overlap at each end. Band 1 covers 20.7 Mcs. to 21.6 Mcs., band 2 covers 13.9 Mcs. to 14.5 Mcs. and band 3 covers 6.9 Mcs. to 7.3 Mcs.

It should be pointed out that the results to be expected will be determined to a large extent by the type of broadcast receiver that the converter feeds into. It should preferably have an RF stage of its own, although this is not strictly essential. However, lacking this stage, the overall sensitivity will not be as good as if one is included.

While this converter will give an excellent account of itself, it must be also borne in mind that, for serious SSB or CW operation, something more than a simple broadcast receiver will be required in the rear end. A broadcast receiver lacks the essential BFO and extra selectivity that is most essential for this specialised type of listening.

SEPARATE IF CHANNEL

However, there is no reason why someone desirous of a more elaborate receiver should not construct a separate IF channel and add as many refinements as he sees fit. Such an IF channel could well operate with an input of 1500 kcs and then convert down to several stages of 85 kcs for additional selectivity, and include a BFO and possibly a product detector as well.

However, that is getting beyond our present objective, which is to get good results from ordinary amateur phone stations, with a minimum of outlay. If one is to consider a specially designed IF and detector system, with BFO the claims of a crystal-controlled converter have to be considered.

(Such a converter is currently under development.—Editor.)

The construction of this present converter should pose no special problems. The chassis and panel are both made of heavy gauge aluminium for mechanical stability. Any tendency to warp or buckle is bound to upset the stability of the oscillator and make the set difficult to tune.

A common earthing point should be selected for each stage as close to the valve socket as possible and then all earth returns associated with that particular stage should be brought to that point. This includes the earthy end of the grid coil, the HT bypass on the RF primary and the screen bypass capacitor.

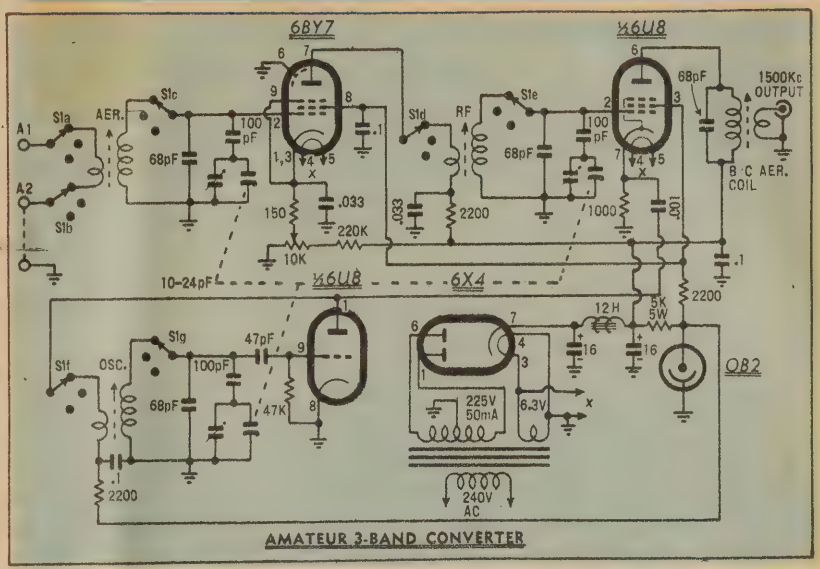
RANDOM EARTHING?

To be sure, the converter might be made to function satisfactorily in some cases, with more random earthing arrangements, but we feel that the little extra trouble and planning is worthwhile as a precautionary measure.

One of the main causes of instability in circuits of this type is multiple earth paths. At the frequencies involved, even relatively short distances between two earth points on the chassis can introduce enough stray reactance and coupling around the stage to cause severe oscillation.

Most important is the earthing of the frame of the tuning capacitor. The gang should be mounted on four insulated pillars and a ground connection made to the frame at both ends, one returning to the common ground for the RF stage and the other to the common ground for the mixer-oscillator.

CIRCUIT OF 3-BAND CONVERTER



The converter has its own in-built power supply, though this could be omitted if sufficient voltage and current is available from the basic receiver to power the converter.

The Band switch should have solder lugs placed under the nuts at each end and leads again run to the common earth points.

A piece of scrap aluminium, 2¼in by 4¼in with a half inch lip folded over is used as a shield between the aerial coils and the RF coils. This shield straddles the socket of the 6BY7 and a cut-out must be made in the shield in order to clear the socket pins.

LOCATING HOLES

In order to correctly locate the holes in the shield for the switch support rods to pass through, first mount the switch on the front panel and then measure the distance between the centre of the shaft and the underside of the chassis. This will be the distance required for the shaft clearance hole in the shield and a switch wafer may then be placed over the hole and the additional holes for the support rods marked and drilled.

This is the only piece of metalwork that requires some care, so that the hole in the front panel and the holes in the shield might be in line. When all the holes have been drilled in the shield, the switch should be disassembled and then re-assembled with the shield placed between the aerial and RF switch wafers.

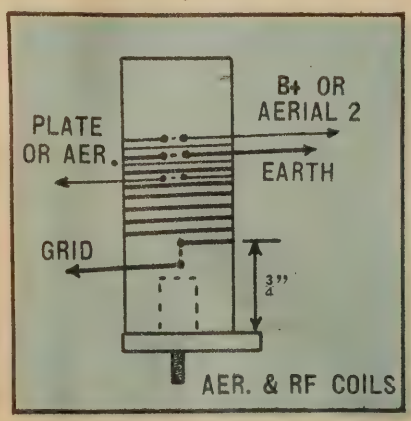
FINAL MOUNTING

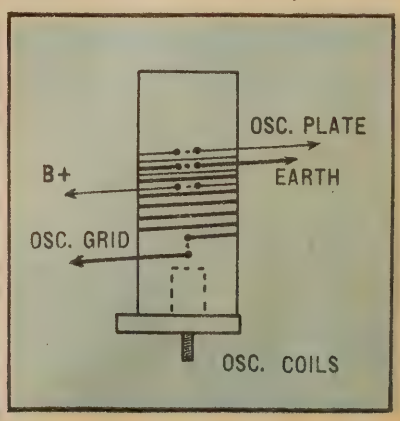
The switch and shield should then be mounted on the front panel and holes drilled through the lip of the shield into the chassis to take the mounting screws. The whole assembly is then extremely rigid and adds a great deal to the overall stability of the set.

The 7-lug terminal strip is mounted alongside the coil assembly and on it are mounted the majority of components associated with the HT line. The 5K dropping resistor for the voltage regulator is also mounted on this strip. The 2-lug tag is mounted close to the RF amplifier socket and carries the RF amplifier cathode resistor.

Pin 6 of the 6BY7 is an internal shield and should be grounded directly and not tied to the cathode.

The unused section on the RF and oscillator switch wafers may be used





These diagrams show the connections to be made to the coils. Note that the windings should be in the same direction.

THE WARBURTON FRANKI PAGE

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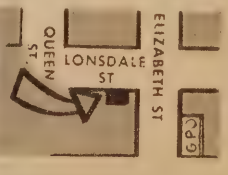

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as a common tie point for the HT connections to the coils.

The 100 pf capacitors in series with each section of the gang should be as close in value to each other as possible, in order for the gang to track accurately over the entire tuning range. We used standard 5 per cent tolerance types which proved adequate for the purpose.

It will be noticed that no series padder capacitor is used in the oscillator circuit. Due to the small band being covered and the relative proximity of the oscillator frequency to the signal frequency, it is possible to eliminate the padder and yet obtain almost perfect tracking from one end of the band to the other.

THREE TRIMMERS

Departing from normal practice, we have only used three trimmers to tune the nine coils in the converter. We found that we were able to adjust the trimmers correctly on the high frequency band and that the setting held good for both the lower frequency bands as well.

It is often a problem to find sufficient space to mount the required number of trimmers if one is used across each coil. In our case, however, the problem does not arise and the trimmers were mounted conveniently on the tuning gang itself.

As far as the oscillator circuit is concerned, the coil slugs are individually adjusted to set the correct lower frequency limit of each band. The oscillator trimmer is then adjusted to set the correct upper frequency limit for the 15 metre band and this setting automatically determines the correct upper frequency setting for the two lower bands and requires no further adjustment.

As can be appreciated from the foregoing, the inductance of the coils is fairly critical and it is for this reason that we have included slugs in each coil for optimum adjustment. Even so, the amount of inductance change that can be effected with a slug of the diameter we are using is only a few per cent of the coil inductance, as wound, and again some care must be exercised in following the coil data if the results are to be duplicated.

OPTIMUM SETTING

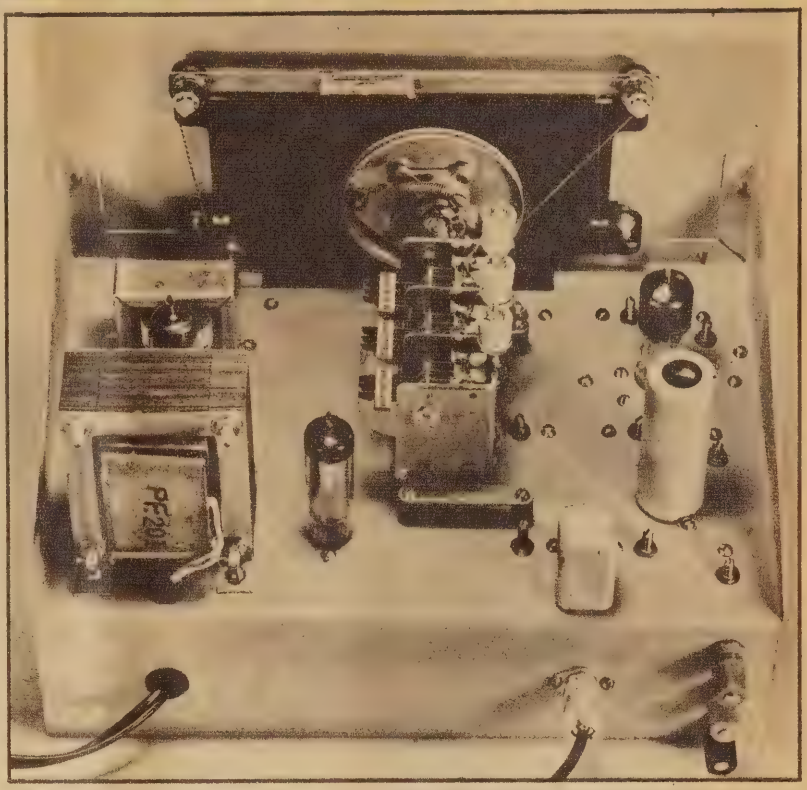
Commencing each secondary winding approximately ¼in from the slug end of the former, we found that the optimum setting for each slug occurred about midpoint of its travel. This, of course, will vary with individual constructors, but indicates that the coil inductance may be varied either way by approximately equal amounts and that the figures given in the data are design centre values.

As the converter only tunes a very narrow band, it is possible to design the aerial coil primaries to present an optimum match to the line from the aerial. Normally this is impractical, due to the wide band normally covered and to the random lengths of wire that are sometimes strung up as an aerial. It is assumed that, in an amateur installation, some attempt at least will have been made to provide a correctly matched, resonant aerial system.

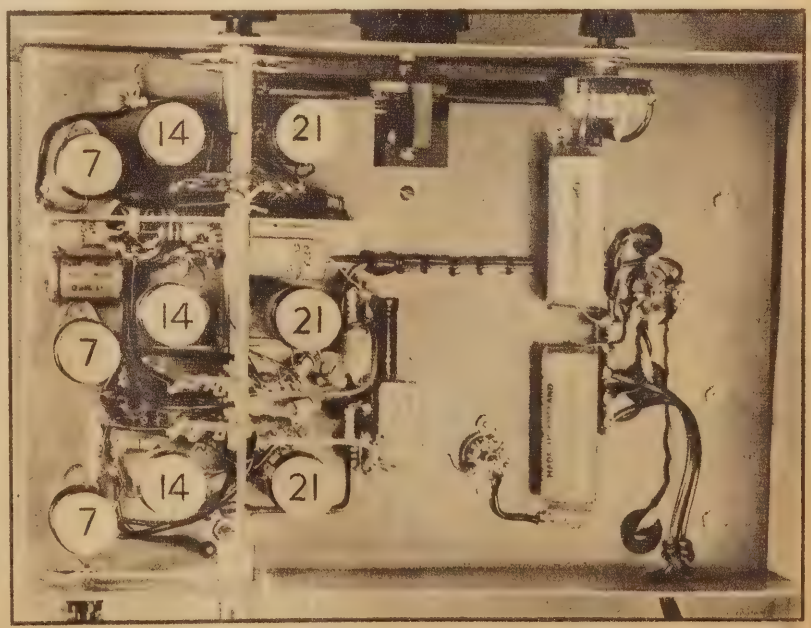
In our particular case, the inductance of the aerial coil primary is so chosen as to present a nominal 70 ohms impedance in the centre of each band being covered. Provision has also been made for either balanced or unbalanced input, depending on the type of aerial system and feeder in use.

Should it be desired to cover the 10 metre band, it will be necessary to drop one of the other bands in order to

A REAR VIEW OF THE CONVERTER



This top view of the chassis clearly indicates the layout of the major components. Note the insulated pillars supporting the tuning capacitor. The voltage regulator is to the right of the power transformer.



The position of the coils around the wave change switch is important in order that lead lengths might be kept to a minimum. A solder lug should be placed under the nuts at each end of the switch and an earth lead run to the common ground point for each stage.

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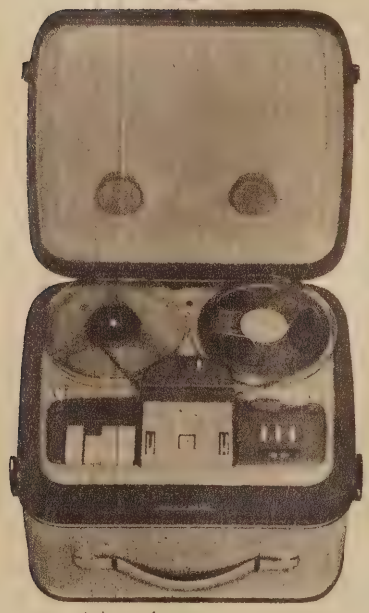

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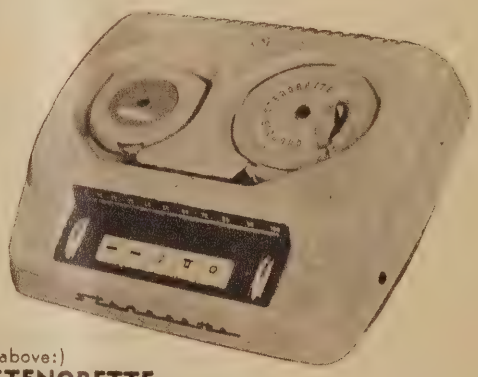

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accommodate the other coils. We have not done any experiments in this band, but there is no reason why such a band could not be included and the 40 metre coils removed. If the 100 pf capacitors are removed from in series with the gang, the capacitance change will then be just sufficient to cover 28 to 30 Mcs.

While the dial mechanism is an important part of the converter, we have not specified any particular type, leaving it rather to the individual constructor to decide on what he will use. The only point to watch is the matter of smooth operation and freedom from backlash. Calibration of the dial scale will again be an individual matter as some may wish to use semi-circular scales while others use a straight line scale.

In our own set we used a standard Efco straight line dial, simply because it happened to be on hand. Although in the photograph the dial was shown uncalibrated, we later inserted a calibrated card behind the glass and glued it to the metal back plate of the dial assembly. Others may desire to follow this method, which has proved very satisfactory.

The connection between the converter and the receiver must be well shielded to prevent any pickup of signal at 1500 Kcs. For this reason also, it is not possible to use a receiver with a built-in ferrite aerial, as it will be well-nigh impossible to eliminate unwanted signal pickup. The lead between the output coil in the converter and the co-ax output socket should be kept very short as this, too, may provide a source of unwanted signal pickup.

POWER SUPPLY

If the power supply in the broadcast receiver is sufficiently large, and can handle an extra 45mA of HT drain, the inbuilt supply may be eliminated and additional leads run from the receiver to the converter for both HT and heater voltages. In some cases, it may be necessary to include an additional dropping resistor to limit the voltage to the converter to 250 volts.

Alignment of the completed converter follows normal practice with one or two exceptions. It must be borne in mind that the use of a signal generator is almost a "must" as far as the alignment of a short wave receiver is concerned and attempts to peak the tuned circuits on noise or stations will frequently result in a performance that is well below maximum.

A shielded lead should be connected between the output of the converter and the aerial terminal of the receiver and a signal generator connected between the control grid of the 6U8 and earth. Some form of output indicator will also be required to assist in accurate peaking of the tuned circuits.

The signal generator should then be set to 1,500 Kcs. and the broadcast receiver tuned to that frequency. The slug in the plate coil of the 6U8 is then adjusted for a peak in signal output. The converter is best switched to the 40 metre band for this preliminary alignment.

Remove the signal generator from the mixer stage and connect it across the aerial terminals of the converter. Switch to the 15 metre band and adjust the appropriate oscillator coil slug so that 20.8 Mcs. falls about a quarter of an inch from the bottom end of the dial scale. Both aerial and RF coil slugs may then be adjusted for peak signal.

REPEAT PROCEDURE

Tune to the top end of the band and adjust the oscillator trimmer so that 21.6 Mcs. falls just short of the upper end of the dial scale. The aerial and RF trimmers are then adjusted for peak signal. This procedure should be repeated two or even three times to ensure the absolute optimum peak of all cores and trimmers.

Switch to the 20 metre band and adjust the oscillator coil slug so that 13.9 Mcs. is the lower limit of the band. The Aerial and RF slugs are peaked as before but no further adjustment should be made to any of the trimmers. If everything is in order, it will be found that the upper limit of the band will fall at 14.5 Mcs. and that the aerial and RF trimmer settings are very close to optimum.

The 40 metre band is aligned in a similar fashion, the lower limit being set at 6.95 Mcs. when the upper limit will automatically fall at 7.3 Mcs. and the trimmers again should not be adjusted.

Finally, all trimmers and cores should be sealed with either wax or varnish to prevent any accidental movement that would throw out the alignment. The intermediate points on each band may now be marked in on the dial, preferably, of course, in black ink.

Although, as a rule, we do not quote performance figures we felt that the image ratio achieved with this converter was worthy of mention. On the 15 metre band the image was down some -45db. and on 20 metres down -60db. On 40 metres the figure was well in excess of -70db. These figures are only quoted to give indication of what can be achieved if the alignment is carefully carried out.

We feel that this little converter is worthy of a place in any ham shack or SWL den and will really justify the care and effort put into its construction.

COIL DATA

Band 1 (15 metres)

Aer.: Primary 4 turns, 16 TPI, 1 turn interwound with secondary. Secondary 4 turns, 16 TPI.

RF.: Primary 3 turns, 16 TPI, 1 turn interwound with secondary. Secondary 4 turns, 16 TPI.

Osc.: Primary 2 turns, 16 TPI. Secondary 3½ turns, 16 TPI.

Band 2 (20 metres)

Aer.: Primary 5 turns, 16 TPI, 1 turn interwound with secondary. Secondary 7 turns, 16 TPI.

RF.: Identical with Aerial coil.

(Continued on Page 139)

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Amateur Correspondent, Bill Moore, Says:—

A POINT in question these days is why so few amateurs attend meetings and engage in the administrative side of the amateur service.

Perhaps the greatest contributing factor is the time involved by participation in the hobby. Equipment is complicated by necessity, if one is to effectively cope with the crowded bands; secondly the average amateur is seldom satisfied for long with his gear. Build and rebuild becomes a vicious circle.

Thirty or so years ago a piece of board, some copper tube and a few components, plus a day's work, saw a transmitter on the air. Another day to build a regenerative receiver and a few hours for a zepp antenna erection put the average amateur in business.

In these days of high pressure business, complicated amateur equipment, etc., don't forget the amateur who is prepared to give of his spare time on the administrative side; credit and support must be given him. Effective organisation and representation via the WIA at all levels is very necessary for the welfare of the amateur service. Don't desert these workers; they want your support at meetings and in their efforts on your behalf.

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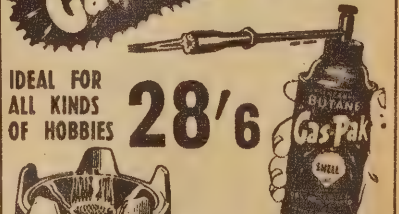
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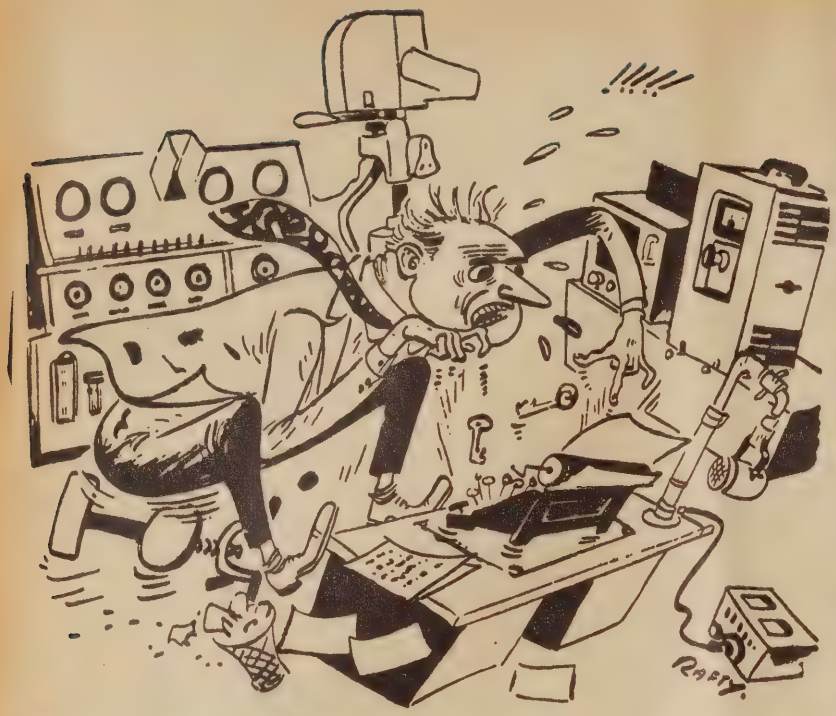

Let's Buy An Argument

This month, for "Argument," I have a very mixed bag of letters but that is probably all to the good from the point of view of general interest. We start with colored television and end up goodness knows where!

by Neville Williams

THE first letter comes from a reader in Adelaide, over the initials H.F. It is presented in the panel opposite and I suggest you read it at this juncture and form your own opinion.

Does it contain the germ of a bright new idea or is it based on false premises?

I'm afraid my vote has to be cast with the latter group. In good old "Orstralian," our correspondent is "barking up the wrong tree."

If we go right back to fundamentals, the colour content of any scene, whether viewed directly or artificially reproduced, is identified with the light rays reflected or issuing from that scene.

MORE DEFINITE

In general, colour values are more positive towards the highlight end of the range and subside towards an eventual "no-colour, no-light black" in the deep shadows.

In other words—and what I am trying to say—is that normal picture presentation involves having the lighter portions of the picture at their proper colour values, with the deep shadows subsiding towards black, where no definite colour is evident.

In the systems of tinted or colour television, which have thus far been promoted, this basic requirement has been met.

Take, for example, the idea of "tinted" television, which we discussed rather unflatteringly in these columns some months ago. Or was it years?

This involved placing a transparent screen in front of the safety glass, tinted blue at the top, a brownish hue in the middle and green at the bottom.

The light beam, scanning near the top of the picture, was seen through the blue section and ONLY blue rays emerged from the combination. Where dark areas near the top of the screen caused the beam to be cut off, NO light emerged. Thus, the range of tone was from full blue highlights to neutral black.

Similarly for the other areas involving brown and green.

In the case of true colour television systems, the method of colour synchronisation allows independent colour values to be built up over any portion of the screen area and according to the colour distribution of the original scene.

In the sequential frame system, the screen is viewed through the sectors of a rapidly spinning colour wheel. A normal black and white picture tube is employed but, because the white spot is seen in turn through red, green and blue filters, the system presents ONLY these colours to the viewer at the appropriate instants, and then only over the illuminated portions of the screen.

PROPER COLOURS ONLY

In the case of the dot-sequential system, as currently employed, the phosphor dots present ONLY their appropriate colours to the viewer, the colours being most apparent when the beam current is highest, corresponding to a highlight.

(The thought of "white" highlights does not negate this statement, because white highlights result from the superimposition of the three primary colours, all fully active.)

Now let us have a look at the method suggested by our correspondent, H.F.

His proposal is to use coloured light sources to "tint" a safety screen placed in front of the tube face. Now let's do a spot of imagining.

We are seated in front of a normal television receiver and viewing an ordinary black and white picture, with no added light. So far, so good.

Now we gradually turn up the brightness of a red light source, so placed that a red glow is manifest over the whole face of the safety screen substitute.

DOES NOT FILTER

This red glow does NOT filter the light from the scanning beam. Highlights will continue to look substantially WHITE, because they still contain their full original complement of constituent colours.

The main effect of the red glow will be to tint the deep shadows, where there is no other light from the tube face to "wash out" the colour.

In other words, the method suggested by our correspondent completely reverses the normal order of things by having maximum colour in the shadows and least colour in the well-illuminated areas.

And, of course, by lighting the

hadows, whether by coloured light or otherwise, the contrast range will be proportionately reduced.

Precisely the same objection will apply, whether the method is used to "tint" television picture artificially or to colour it by any properly synchronised method. At best, it could only be a combination of coloured shadows and white highlights.

In fact, the scheme is foredoomed to failure for synchronised colour on other grounds.

Firstly, the dark picture segments, which are the only ones which the method could effectively tint, are the very segments for which the transmitted signal contains the least colour information.

MERGE INTO WHITE

Secondly, a succession of primary colours, flashed over the whole screen area, at either frame-sequential or dot-sequential rate, would simply merge into white light, defeating the whole object of the scheme.

Little or no colour would remain.

In short, I can't foresee any glowing future for the scheme suggested by H.F.

He may be able to get some fancy tinting effects but the idea certainly wouldn't be capable of extension to synchronised colour presentation.

As for fancy tinting effects, I doubt that they have much future either. If advertising and publicity are any measure, the idea of tinted television has already terminated its very brief existence.

If H.F. or anybody else really wants to make a fortune, the idea would be to evolve a safety-glass replacement which could change its wavelength as a FILTER in response to appropriate mechanical or electrical stress.

In the hectic days when conflicting interests in the U.S. were spending vast sums to sponsor rival colour systems, the scientists and engineers concerned must have lain awake nights trying to dream up some such scheme—but without success.

Personally, I have a feeling that a method will ultimately be devised of producing a variable frequency filter and what a vista it will open up. Colour television would be just one application.

We shall see.

Still on the subject of television, the second letter in the panel asks whether we can explain the cause for an alleged prevalence of "negative ghosts" on all channels in the environs of Adelaide.

TO BE OR NOT TO BE . . .

Well, first, I have only the particular reader's word that negative ghosts are, in fact, prevalent in Adelaide. There may be others who are prepared to say they are not. On this matter I can have no opinion, without calling for further evidence.

I am reminded of the several hours which I spent, while in hospital recently, in close proximity to a gentleman having an attack of delirium tremens.

In fairly rapid succession, he

1. Complained of so many dogs being left to run loose in the ward.

2. Warned about a gunman who was peering at me from behind a nearby pillar, and

3. Enjoyed a complete vaudeville show at the other end of the room.

Frankly, I couldn't see the dogs nor the gunman and I completely missed the vaudeville. But there were no doubts about it all in the mind of the gentleman concerned.

I shall therefore leave it to the residents of Adelaide to resolve the existence or otherwise of the phenomena.

Seriously, though, I have not come across much detailed discussion of negative ghost effects. For example, in "Basic Television," by Grob, he mentions that multipath reception can produce ghost images and these can be positive or negative, depending on the "relative phase between the multi-path RF signals."

NOT OVERSHOOT

There are references elsewhere and in other literature to a reversal of tone values due to overshoot but our correspondent points out that this cannot apply to negative images displaced so far from the real one.

Nor can it be a question of an overloaded IF stage producing a distorted or inverted modulation envelope.

I think I'll throw this one back to readers for comment as follows:

1. Is television reception in Adelaide plagued by more than its share of negative ghosts?

2. If so, and in any case, what is the explanation for them, couched in terms less vague than heretofore?

From a reader in Coonamble, N.S.W., comes a letter commenting on the performance of transistorised broadcast receivers. I might mention, for those who have not heard of Coonamble, that it is a country town and therefore one where the DX performance of receivers would be considered important.

Because of this and the fact that our correspondent is a professional radio technician, the opinions expressed carry some weight.

The letter runs as follows:

"Dear Sir,

"I would like to take you to task concerning some of the remarks made in the Argument series in the September issue concerning transistors.

A NEW SYSTEM FOR TV COLOUR?

Dear Sir,

I think I have an idea which may be worth following up. I have checked through the Patent Office in Adelaide without finding anything similar to it. Since I have no money at present to pursue a patent, I may as well forget it but I would still like your opinion of it.

I was thinking of a method of improving black and white television into colour.

As you will probably remember, in America around 1950 somebody let a three-colour disc revolve in front of a television set to obtain a colour image. Of course, it was pretty big.

So I got to thinking. Why not light or illuminate the safety screen on a television set with a coloured light? The trick would be to use a kind of perspex screen, as this has no colour of its own. Plain glass lights up either green or blue.

I obtained very good results by applying a thin coating of a mixture to a sheet of perspex to keep the light (or colour) in the screen.

To obtain a good colour scheme, I used a prism and focused the coloured beam into the screen. There are other means but they need improvement.

A perspex screen could be fitted to any make of TV set instead of the safety glass.

Well then, instead of revolving a big disc of three colours, why not illuminate a (perspex) safety screen with any colour of the rainbow by vibrating or rotating the prism?

The principle would be the same as far as impulses and synchronisation is concerned and would it not be good to have coloured television from a black and white picture tube?

I have been thinking a lot about it and have made quite a few drawings but I would like your opinion about it first.

Yours faithfully, H.F.

NEGATIVE TV GHOSTS

Dear Sir,

I have a television query. Can you explain the cause of negative ghosts; that is, ghosts with reversed modulation characteristics?

Synch. pulses and blanking pedestals become white vertical stripes, when appearing as ghosts and the entire ghost picture is a negative.

I live in a difficult situation in the eastern suburbs of Adelaide, about 3½ miles airline from the transmitters but shielded severely by a hill. Ghosting is quite a problem, as the direct signal is very weak.

I raise the question not so much because of the nuisance value of the said ghosts (conventional ones are bad enough!) but because no one has given me a satisfactory answer as to how the entire modulation structure can be reversed on reflection. Why an increase in transmitted power (to say synch. pulse level) will cause a decrease of received power (i.e. towards white).

I hasten to point out that all received signals are comparatively weak (hence no overload) and that displacements of about 6in exist (hence no ringing or overshoot, etc.).

The effect is visible on all channels and can be seen faintly all over the Adelaide area, particularly when viewing lettering on a plain background, with many different types of receiver.

I hope you can find an answer.

Your faithfully, A.F.

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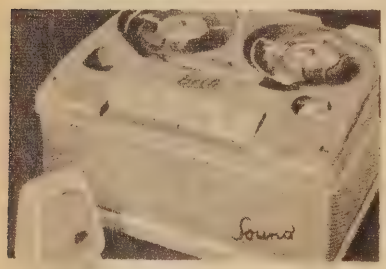

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The famous Belle Tape Recorder is now available at this record low price for the first time in Australia. The Belle features push-button operation, 1½-hours playing time, twin track and price includes microphone and long-playing tape.

49 gns. £6/10/- dep.

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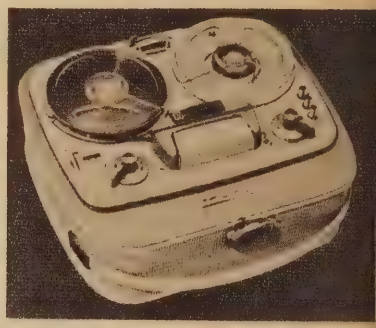

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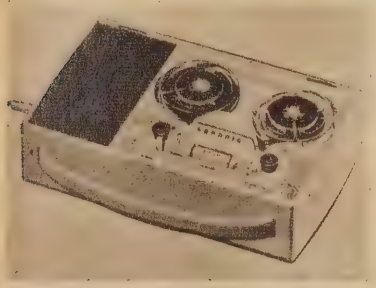

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"While I do not agree with some of he statements made by your corres-ondent, I have had similar experi-ences with transistors, especially in ransistor radio servicing.

"Firstly I do not agree that the prob-lem of temperature compensation for transistor radios has been solved.

"I have noticed that most transistor radios are greatly affected by tempera-ture and humidity, the results varying from lack of sensitivity to oscillation during a hot or humid day. I have found this even in high-priced sets of well-known manufacture.

NOT AS GOOD

"Secondly I agree completely with your correspondent in his statement that transistor radios do not perform as well as valve radios in country areas.

"I have found that the inherent noise level in transistor sets is too high, al-though at least two commercial radios using RF stage and separate oscillator stage are quite passable. Even so, they are not as good as a valve radio.

"Also most transistor sets are too in-selective and have bad image response. I have noticed at night particularly that transistor sets bring in a lot of joeys, morse signals and phone stations on the lower short wave band when they are supposed to only receive broadcast stations. This trouble does not occur with valve radios.

"Actually this is quite understandable as the transistor has a low resistance between base and emitter, while the resistance between grid and cathode of a valve in RF and IF stages is infinite.

"The low resistance from base to emitter of the transistor would shunt the secondary of the coil thus affecting the 'Q' of the coil.

"The practice of connecting the base to a tapping well down the coil would undoubtedly help but does not com-pletely solve the problem.

"Perhaps in the not too far distant future, transistors will be manufactured with an almost infinite resistance be-tween base and emitter, and set per-formance will be improved.

"While writing to you, I would like to air another pet grouch. Too many advertisers of audio equipment are ap-parently using too freely such words as high fidelity, semi-professional model, broadcast model, studio type, etc., the last three usually in connection with turntables, pickups, microphones and tape recorders.

NOT AS CLAIMED

"I have examined and heard some of these so-called professional items, and can assure their manufacturers that if they took their product to a broadcast station, the engineer would probably throw the thing at them.

"This may appear a little too drastic, but why all this silly business when advertising a product. No reasonable man expects to buy a £100 article for £10. So if the manufacturers just pub-lished correct technical details of their equipment, this would be sufficient in-stead of some of the meaningless clap-trap which we constantly see.

Yours Faithfully, P.J.J."

Well, many thanks for the letter, P.J.J., but it doesn't take me to task nearly as much as one might have expected from the opening preamble.

In fact, when I first read it, the main impression was one of surprise that I had apparently stated so categorically that the problem of temperature sen-sitivity had been solved. I certainly couldn't remember saying as much and, what's more, I don't believe it has been solved.

When I checked back on the issue, I saw what had happened. The main text of the article, as written, indicated quite clearly that transistor equipment did suffer from temperature effects, that measures could be taken to offset them but it concluded as follows:

" . . . . .it would be better if such measures were not needed and one of the areas for active transistor research is the problem of rendering transistors less sensitive to temperature."

WHODUNNIT?

Unfortunately, during the course of laying out the article, someone dropped in the cross-heading "Problem Solved". Hence our correspondent's quite under-standable reaction.

All I can say is that next time I have to write an article in hospital, and next time somebody else writes the crossheads, they can answer for them-selves the argument that such cross-head might promote.

P.J.J. expresses the hope that tran-sistors will ultimately be developed with almost infinite resistance between base and emitter. So do I, P.J.J., but the fulfilment of such a hope would call for a break-through in transistor de-sign which, as far as I know, isn't even envisaged at the moment.

If a transistor or even a circuit technique could be evolved, which would secure near to infinite input impedance, it would be a notable forward step.

Our correspondent's final point about the terminology used to describe audio equipment is one with which I heart-ily agree. It would be very helpful in-deed if all concerned could be per-suaded to follow a certain code in re-lation to the use of adjectives and ex-pressions describing audio gear.

What we sometimes fail to realise, however, is that the practice of de-scribing products in over-euphemistic terms is not confined to audio gear. It is almost universal. It touches everything from the land on which you might like to build a weekender, to the car you could use to travel there and the food you might consume while in occupation.

While we, as the buying public, con-tinue to react so positively to the su-perlative, so long will it be worthwhile for advertising agents to use it.

OURSELVES TO BLAME?

We try to be realistic in our own technical articles and we likewise try to encourage a similar sense of realism among our advertisers, with a rea-sonable amount of success. But we can do little more than complain if terms which we regard as rather "sacred" are subject to misuse in other company.

The final letter, above, I'll leave you to work out for yourself. It isn't radio, it isn't even electronic but it has that slight mathematical flavour on which some of our readers thrive.

Perhaps I should explain that our

(Continued on Page 143)

DOESN'T LIKE DECIMAL CURRENCY

Dear Sir,

As a regular reader of R. & H. for the last 10 years I have now found something to argue about — the article about decimalisation of our currency. Or should I say "against our present system," by R. Michel?

The Australian — or British — pound is one of the most remark-able pieces of currency in the world today.

To show what I mean, how many ways can it be divided without fractions of a penny coming into the calculation? The answer is 20 different ways, as against the dol-lar being divisible only eight dif-ferent ways.

The following table shows how these may be divided:

Pound: 1, 2, 3, 4, 5, 6, 8, 10, 12, 15, 16, 20, 24, 30, 40, 48, 60, 80, 120, 240.

Dollar: 1, 2, 5, 10, 20, 25, 50. 100.

Of course, if the ha'penny and farthing were used, just think of the divisibles, as there is no "half cent" or "quarter cent."

Similar to this, the mile is also divisible into yards more times than the kilometre is divisible into metres. Admittedly if you go to the smallest unit, the kilometre is divisible many more times, as a micron is equal to only .000004 of an inch.

If we are going to scrap any-thing, why not make a clean sweep and scrap our "decimal to the base 10" System and use the more con-venient "decimal to the base 12" which is quite easy to learn and actually easier to use than the "base 10" system, especially in high numbers.

An example:—

Base 10:— 1, 2, 3, 4, 5, 6, 7, 8, 9, 10.

Base 12:— 1, 2, 3, 4, 5, 6, 7, 8, 9, E, Z, 10.

In the base 10 System 143 is written 143.

In the base 12 System it would be written ZZ only two figures as against our present three.

Less figures are used when the really high numbers are reached. For instance:—

The number 128,670 would be written ZZE94. (There is nothing special about this number — it was picked at random.)

The greatest advantage about this system though, is that the basic is divisible by 1, 2, 3, 4, 6 and 12 (6 times) whereas the present system is divisible only four times (i.e. 1, 2, 5 and 10).

Well—I hadn't intended to write such a long letter — but there it is.

Yours truly, L.C.D. (Sturt, S.A.).

P.S.: I'm serious about changing over to the base 12 System even though the letter is flippant.

The Amalgamated Wireless Valve Company wishes you a very Merry Christmas and continued prosperity in the Coming Year.
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BOOKS - REVIEWS AND COMMENTS

"MOON BASE," by T. C. Helvey. Stiff paper cover, 72 pages, 5½in x 8½in. Published by J. F. Rider Inc., New York.

Written with the express purpose of emphasising some of the many problems facing space research, this book seeks to eliminate some of the distorted facts and fancy ideas popularised by semi-scientific articles on the subject.

The author makes no apology for using scientific and technical terms unfamilar to the layman. Indeed, he does so in the hope that such expressions will cease to be strange and take on a fuller meaning to the man-in-the-street and at the same time prove a medium for his technical education.

The book itself is divided into two parts. The first section deals with the technical factors involved in the establishment of a Moon Base, covering such items as construction materials, equipment, communication and radiation hazards.

The latter section deals with the human problems likely to be encountered, including size of crew and the various psychological factors involved, medical and dental problems. Methods of training for future operational teams are also suggested. In order that the average reader might not become too confused with terminology, a glossary is included.

By no means light reading, the book however accomplishes its aim in presenting, in a factual and scientific manner, information of interest to all concerned in the progress of space exploration.

Our copy came direct from the publishers. No Australian price has been mentioned. However the book should be available from technical bookshops in the near future. (A.D.N.).

★ ★ ★

"MAGNETIC AMPLIFIERS"—Principles and Applications, by Paul Mall. Soft Cover, 101 pages, 5½in x 8½in. Published by J. F. Rider Inc., New York.

Due to the rapid expansion in the field of magnetic amplifiers and associated devices, this book endeavours to provide the necessary fundamental information, so that the reader, already acquainted with basic electrical theory, may be able to apply himself intelligently to magnetic circuitry.

The book assumes a reasonable knowledge of electrical fundamentals and commences with a review of magnetism, electromagnetism and magnetic circuits. While mathematics is kept to a minimum, the coverage of the necessary theory is quite thorough.

Following the basic theory, saturable reactors are introduced, followed by the various types of magnetic amplifiers, their construction and use. Maintenance and servicing are also covered and various practical applications of magnetic circuits.

Briefly, this book provides an excellent starting point for those interested in entering the field of magnetic amplifiers and other magnetic devices.

Our copy direct from the publishers. Copies should be available on the local market in the near future. (A.D.N.).

"PRACTICAL RESIDENTIAL WIRING," by John F. Nowak, second edition. Hard cover, 511 pages, 6in x 9in. Published 1960 by D. Van Nostrand Co. Ltd., London.

The second edition of this handbook has been prepared as an aid both to the tradesman and electrical student.

Detailed information is given on wiring methods, both in general and also for particular installation. Chapters are devoted to reading of plans, testing of completed installations and fault finding.

Unfortunately, while published in England, the book deals only with standard American wiring practice and much of the detail is of little value to the local tradesman. Reference is made to American National Electrical Code regulations, which have very little in common with local regulations.

However, the book provides an excellent source of information to those interested in studying current American wiring practice, and some of the more general information will likewise prove of interest.

Our copy direct from the publisher. No Australian price has been advised. (A.D.N.).

★ ★ ★

"HOW TV WORKS," by the Granada TV network. Stiff paper cover, 48 pages, 9½in x 7½in. Published by Methuen and Co., London.

This elementary, non-technical book presents, in a simple manner for the layman, something of what goes on behind the scenes in a TV station.

Rather than enter into technicalities, the book seeks to show something of the tremendous amount of organising required before a station is able to place a program on the air. Chapters are devoted to the operation of the control room, studios and cameras, as well as to outside broadcast procedure.

As no attempt has been made at the technical aspects of TV, the fundamental differences between British standards and Australian standards rarely arise and the information contained may be taken as being generally applicable to Australian conditions.

Our copy from the Technical Book and Magazine Co. Pty. Ltd., 295-299 Swanston St., Melbourne. Australian price 8/6, plus 1/- postage. (A.D.N.).

★ ★ ★

INSTALLING HI FI SYSTEMS, by Jeff Markell and Jay Stanton. Stiff paper cover, 224 pages, 8½in x 5½in. Gernsback Library Book No. 86.

This book provides a comprehensive coverage of the needs associated with the installation of Hi-Fi equipment. Very little reference is made to specific circuitry, the aim of the book being to obtain the best effect, both acoustically and also from an aesthetic point of view, from existing equipment.

The authors, one a hi-fi furniture designer and the other an audio engineer, have presented, each in their own field, a great deal of practical information of benefit to the hi-fi enthusiast.

The first half of the book deals with actual installation problems and type of equipment likely to be encountered. One chapter is devoted to noise and interference problems and their cure. Another is given over to a discussion of speaker baffling methods, room acoustics and echo effects.

The latter half of the book is mainly concerned with the actual housing of the equipment, several chapters being devoted to the construction of suitable cabinets and enclosures. Correct layout of the various items of equipment in order to achieve aesthetic effects is discussed at some length.

This book should meet the need of the enthusiast who, wishing to obtain the best from his equipment, is prepared to put some time and effort into achieving that end.

Our review copy came direct from the publisher but supplies should shortly be available through technical booksellers. (A.D.N.).

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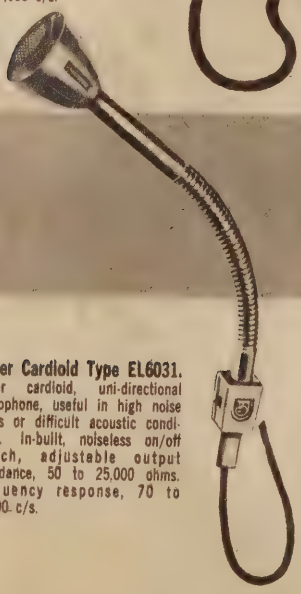
Pencil Microphone Type 1116 or 1117. Ideal for general studio use (for roving and orchestral pick up) and all applications requiring a high-quality microphone. Frequency response, 35 to 15,000 c/s.



Hyper Cardioid Type EL6031. Hyper cardioid, uni-directional microphone, useful in high noise levels or difficult acoustic conditions. In-built, noiseless on/off switch, adjustable output impedance, 50 to 25,000 ohms. Frequency response, 70 to 15,000 c/s.

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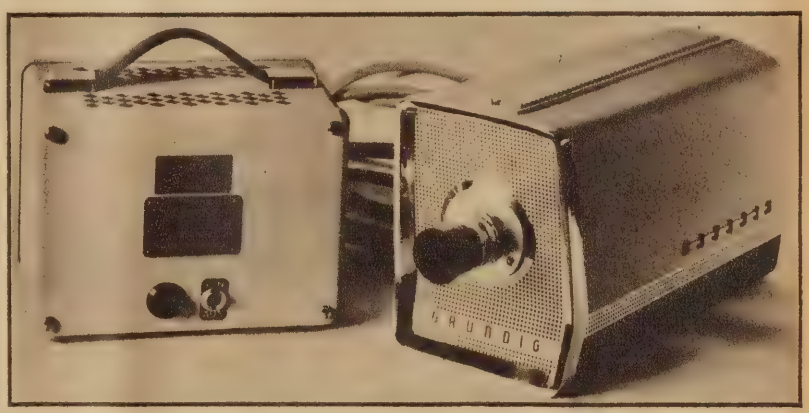
TRADE REVIEWS AND RELEASES

CLOSED-CIRCUIT TV CAMERA FROM GRUNDIG

Shown at the right with its power supply is the Grundig "Fernauge" Model FA40 television camera, released recently by Jacoby Mitchell and Co., Pty. Ltd. of 469-475 Kent St., Sydney. It is intended for closed-circuit use in conjunction with standard receivers.



The Grundig FA40 camera and power supply are used with any normal TV receiver to form a closed circuit viewing system. Applications are in banks, department stores, security services and schools.

MEASURING only 11.4in x 7.2in x 5.4in, the camera is complete with RF oscillator and modulator. It thus provides a complete video carrier signal suitable for injection at the aerial terminals of a standard TV receiver. Although set for channel 5, the oscillator can be adjusted to suit adjacent channels if desired.

As the camera uses a Vidicon tube, it has quite impressive sensitivity. This is particularly true when the f/1.5 50mm lens normally supplied is used. However, the familiar vidicon image retention is, of course, present, making the outlines of fast-moving subjects blurred due to smear. For the applications envisaged for this unit, however, this should be of little consequence.

An idea of the sensitivity may be gathered from the fact that we were able to fully modulate the receiver raster on a scene in which the only lighting was a 60-watt table lamp three feet distant. For this test the lens was only opened to f/2.8.

The lenses used, by the way, are normal "C mount" types, as used in 16mm movie cameras. Any lens of this type may be screwed into the camera. A standard 3/8in Whitworth tapped hole is provided for mounting the camera on a heavy-duty tripod.

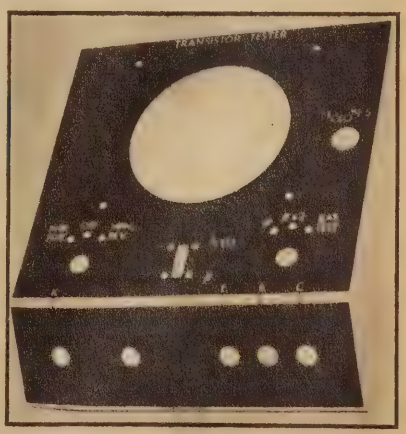
The valve line-up is as follows: Apart from the type 255 vidicon, there are 10 multi-function valves, 3 voltage regulators, 9 germanium diodes and 12 silicon diodes. Power consumption for the complete unit is quoted as 100 VA.

The camera produces a non-interlaced picture having 50 fields per second.

Price is quoted as £398, plus tax. Inquiries should be directed to the above firm.

TESTER PANEL BY R. H. OXFORD Pty. Ltd.

R. H. Oxford Pty. Ltd., of Marriott and Telopea Sts., Redfern, N.S.W., have made available a black-satin finished panel for the R., TV & H. "Transistor Tester" of August this year.



THE panel is well finished and made to dimensions supplied by us. All control mounting holes are pre-punched, allowing immediate assembly. The appropriate case is, of course, available with the panel if desired. We also understand that a version of this panel in multi-colour engraving on a brushed aluminium base will be available.

Intending builders of the tester should be able to procure the panel from normal trade suppliers. However, if difficulty is experienced, the panel may be obtained direct from the manufacturer at the above address.

RCA MULTIMETER KIT RELEASED

Shown below is the new RCA volt-ohm-milliameter kit type WV38A(K) released in this country by Amalgamated Wireless (Australasia) Limited, of 47 York Street, Sydney. It is available either as a kit of parts, or fully assembled and tested.

THE meter has a sensitivity of 20,000 ohms per volt in the DC ranges, and 5,000 ohms per volt in the AC ranges. Full-scale ranges from 2.5 volts to 5,000 volts are provided on both modes of operation. Three resistance ranges are available, the lowest having a half-scale reading of 12 ohms and the highest a half-scale reading of 120,000 ohms.

Six direct current ranges are available on the instrument, ranging in full-scale sensitivity from 50 microamps to 10 amps. Four output ranges and four dBm ranges are also included.

The instrument is well finished in black plastic, with a large, easy-to-read meter face. The price is quoted as £24 plus tax for the kit, and £30 plus tax fully assembled. Inquiries should be to the above firm.

Mechanism as sweet as in a good watch!

CZECHOSLOVAKIAN MIKROMA 2 16 mm CAMERA CUTS COST OF AMATEUR PHOTOGRAPHY IN THREE

- 3 colour slides for the price of 1.
- 36 colour exposures to each casette (developing cost app. 7/6).
- 50 black and whites (developing cost app. 2/6).

FULLY GUARANTEED

Extreme Rapidity in Operation—by advancing the film you set the shutter.

Double Exposure Prevention Device.

Lens. Belar F/3.5—20 mm. lens—great depth of field—focusing range from 18" to infinity—adjustable iris diaphragm.

Shutter synchronised for flash—8 speeds up to 1/400 of a second and "B".

Automatic Exposure Counter for 36 pictures on colour film or 50 pictures on black and white film.

Weight: 7 ozs.

Dimensions: 3" x 1⅛" x 1⅝"

Results with the MIKROMA 2 will astound you. You'll soon be convinced that here is a new field of photography, much more satisfying, easier, and most important of all—much more economical.

CAMERA 19 GNS.

Including either eveready carrying case or pouch with zip.

meopta Mikroma 2

1. Slide Projector: Will take 16mm slides in metal or cardboard mounts. (Conversion adaptor for 35mm projector available.) Miron 2.8/60 mm lens, aspheric condenser lens, brilliant picture. **£14/17/**

2. Slide Viewer: Will take metal or cardboard mounts or film strips. Viewing lens made from optical glass can be focused to suit observer. 7 times magnification. **17/6**

3. Reproduction Equipment: consisting of mounting table, four sets of four extension legs for copying from different heights, supplementary lenses for each copying size obviating focusing (can also be used as a tripod). **£9/17/6**

4. Viewer and Frame Cutter: For the editing of films — comprises magnifier cutter with mechanical frame transport—all in a metal box. **£4/14/6**

OTHER ACCESSORIES INCLUDE:

Box of 30 metal mounts 15/9. Box of 30 cardboard mounts 5/8. Spare take-up casettes 8/2. Spare feed casettes 7/2. Plastic container for either casette 3/-. Re-load of Anscochrome, 36 exposures, 32 ASA 8/6. Re-load of Adox KB 17, 50 exposures, 40 ASA 5/6.

To MEOPTA (Aust.) Pty. Ltd.
33 Higginbotham Rd.,
Gladesville. N.S.W.

☐ I enclose cheque/money order for camera and equipment as list attached OR ☐ Please send me further details—

Tick which ever applicable.

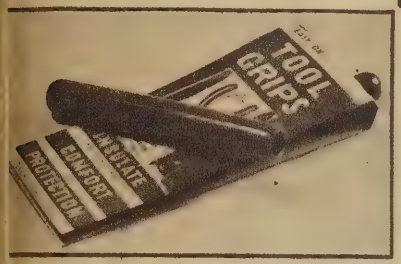
NAME .....

ADDRESS .....

.....

PLASTIC INSULATING SLEEVES FOR TOOLS

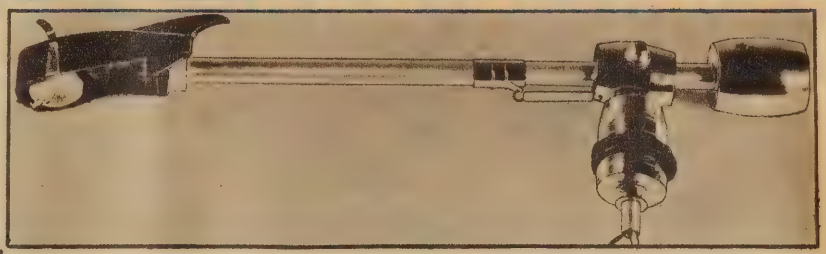
Pictured below is a set of plastic insulating sleeves recently sent to us for review. They are intended to slip over the handles of many common tools such as pliers and garden tools, etc., to provide insulation and comfort.



THIS set may be fitted to the handles of pliers up to the 8-inch size, and larger sizes if softened in solvent.

The sleeves are distributed by R. W. Keane Ltd., of 2a Montrose Street, Hawthorne E3, Victoria. They should be available from all radio and hardware stores at a retail price of 2/6.

NEW ALL-BALANCE PICKUP ARM



Pctured above is the new "All Balance" pickup arm, which has just been released in Australia through Messrs. G. R. D. Instruments Pty. Ltd. of 6 Railway Walk, Camberwell, Victoria.

MANUFACTURED by Messrs. Jobo N. V. Holland, the arm is identical with one made in the U.S.A. by the Sonograf Electric Co., New York.

As the name implies, the arm is designed in such a way that the weight of the head can be balanced in all planes by a single setting of the rear counterweight. Pressure of the stylus against the record is then provided purely by an adjustable tension spring.

To set up the arm, the spring is put in the "O" position. The counterweight is then slid along, until it exactly balances the weight of the head, and locked in position with a grub screw. Sliding the spring clip along a calibrated scale then produces a playing weight of so-many grams, as marked.

With this system, the plane in which the pickup operates is largely immaterial and it will, if necessary, play the record when the latter is revolving in the vertical plane.

Apart from this unusual feature, the arm is designed for maximum versatility. The sliding counterweight can balance a variety of cartridges, while the arm can be rotated axially to ensure an exactly vertical stylus position.

THE HEAD SHELL

The removable head shell is designed to accommodate cartridges ranging from the popular magnetics to turnover crystal types, for which purpose a thin breakaway section is provided at the front to clear the turnover lever. This section also carries an arrow head to facilitate placing the stylus on a particular track.

The head attaches to the arm by a knurled locking ring, four spring-loaded contacts completing the electrical circuit.

Base height can be adjusted over a limited range to maintain the arm level, in the playing position.

A split rubber grommet supplied with the base pedestal, is intended to provide some mechanical isolation from the motor board.

The arm is supplied complete with motor board, mounting template, suggestions for installing well-known heads and an assortment of spacers and screws likely to be required.

On test, in our laboratory, the arm performed extremely well. The bearings appear to be free, without being sloppy and no difficulty was experienced in playing heavily modulated records with a nominal playing weight of 2 grams with a couple of well-known magnetic cartridges.

TRACKS VERTICALLY

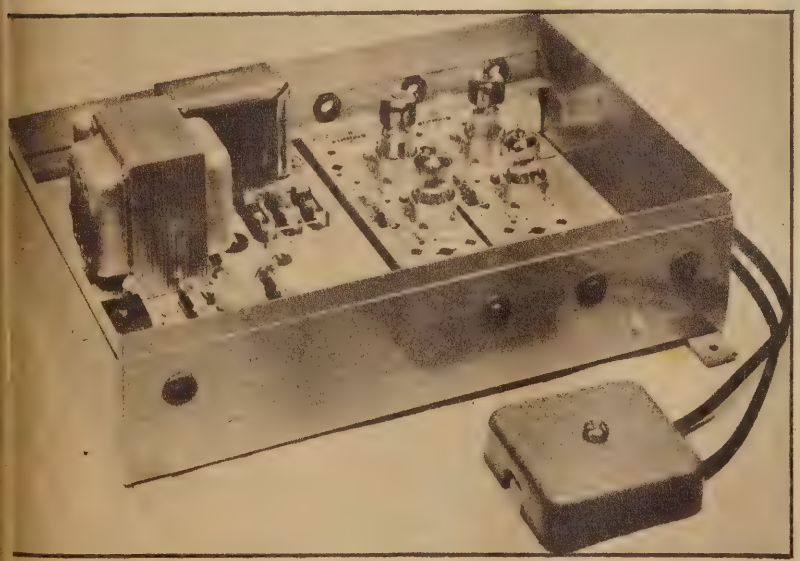
What is equally interesting was the fact that the arm continued to track perfectly with the turntable at 45 degrees and vertical.

In short, the new arm is a noteworthy approach to the ideal for a comparatively modest price.

The arm, as pictured, was supplied with an Elac STS-200-S magnetic cartridge but arrangements are being made to supply without cartridge, as required.

Retail price of the arm, with plug-in head shell but without cartridge is quoted as £12/19/-, this figure including sales tax. Normal trade discounts apply.

TV DISTRIBUTION AMPLIFIERS

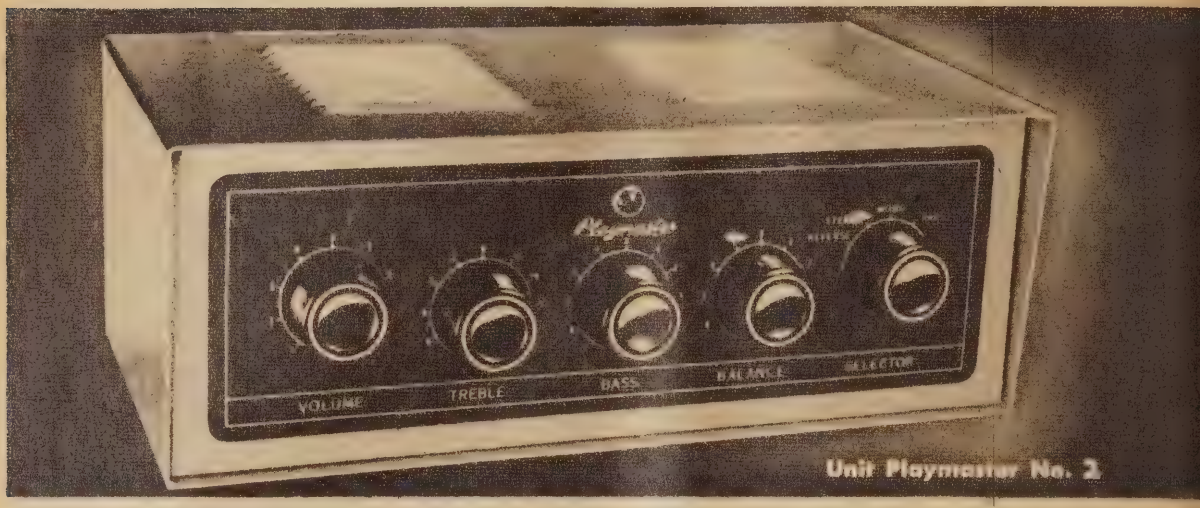


The unit pictured above is the "Cunningham" 189 TV Distribution amplifier. It is intended for use in amplifying antenna voltages, feeding up to 20 sets from a single aerial system under favourable conditions. The unit is self-contained and operates from the 240 volt mains.

THE amplification is carried out by two separate amplifiers, each covering a section of the band. One amplifier serves the channels 2-4 and the other channels 5-11. Output from the amplifiers may be used separately or combined via the diplexer network in the small box visible in the foreground. While we have not been able to test this unit, it would appear to be a good performer. Only two valves are used in each amplifier, but the gains are quoted as 33dB for the low band unit and 26dB for the high band unit. Input impedance may be either 75 ohms unbalanced or 300 ohms balanced, with the output impedance fixed at 75 ohms unbalanced.

Inquiries should be to R. H. Cunningham Pty. Ltd., 8 Bromham Place, Richmond E1, Victoria.

UNIT PLAYMASTER No. 2 14-watt Stereo Amplifier



AT A PRICE ALL CAN AFFORD

Complete kit of parts, **£39/14/-** Wired and Tested, **£49/18/-**

Specifications . . .

Performance figures and circuitry used is detailed in "R.T.V. & H." August, 1960. We supply best-quality components to "R.T.V. & H." specifications in all kits and completely built units.

POWER OUTPUT: A full seven watts per channel, rising to a maximum of eight watts per channel.

VALVES: Four — 6BM8 in twin U/L output. One — 12AU7 twin voltage amplifier.

RECTIFIERS: Two contact-cooled, selenium-type 1N1763 rectifiers.

OUTPUT IMPEDANCE: 15 ohms. Others as required.

SWITCHING FACILITIES: (a) Stereo; (b) stereo (reverse); (c) mono; (d) radio tuner; (e) spare.

TONE-CONTROL RANGE: Treble cut and boost, 12 db; bass cut and boost, 12 db.

BALANCE-CONTROL RANGE: Equal both channels; to cut-off either channel.

INDICATOR BEZEL shows unit in operation.

FINISH: Modern metal case — Seamless welded, baked enamel, beige hammertone, self-contained. Attractive label—coffee brown, gold lettering. Beautiful imported knobs — Brown or ivory, gold centres.

FITTING: Self-contained case (as above). Also available less case for panel mounting.

Almost any combination of good quality speakers and player unit may be used with this remarkable amplifier. We have two extremely efficient combinations which we offer at a most economical price:—

FULLY PORTABLE. Unit Playmaster No. 2 in box. Dual 300.S. Stereo player in case. 2 - Axiette Mark II 8" Speakers.

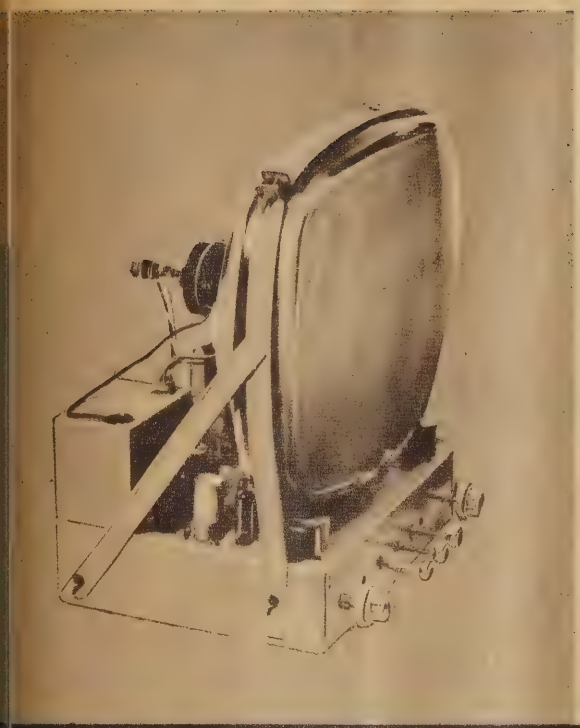
CABINET MOUNTING. Unit Playmaster No. 2 less box. Dual 300.S. Player without case. 2 - Axiette Mark II 8" Speakers.

Neat, compact Cabinet kits to suit 8" speakers are now available.

FULL PLAYMASTER RANGE

There's a Playmaster for every purpose. Designed by "R. TV & H." Playmaster brings you **true** fidelity for an extremely low figure. The range includes 17 Watt Stereo and Mono, 10 Watt Stereo and Mono, 5½ Watt Mono, 13 Watt Mono, plus a complete range of tuners embracing A.M., F.M. and Dual Wave. Also high quality kits to make your own speaker enclosures and equipment cabinets.

BROADWAY ELECTRONICS

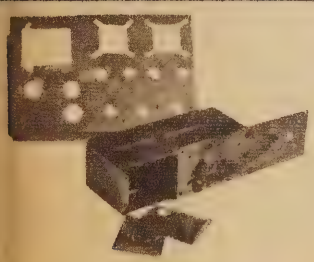


BUILD YOUR OWN TV RECEIVER

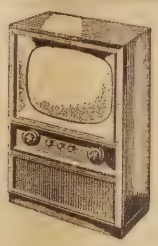
23", 21" and 17" MODELS

"R, TV & H." 110° DESIGN

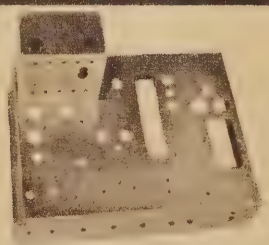
Outstanding results are reported from all States. The kit is complete in every detail. Ready-drilled chassis, all valves, A.W.A. picture tube and deflection components, Q + IF strip and latest Philips or Q + tuner ready wired and matched together. Beatiful imported gold centre knobs, etc., etc. LOW COST—amazingly low for a really first-grade receiver.



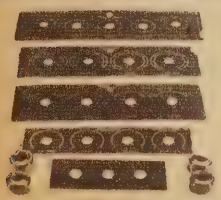
aymaster control unit boxes, ready illed complete with front panels and ockets. High quality hammertone ish. Full range of Playmaster amifier and tuner chassis also available.



Timber kits to construct the 110 degree TV cabinet. Everything precision cut. All parts included, glass, mask, beading, gold insert, speaker grille, etc.

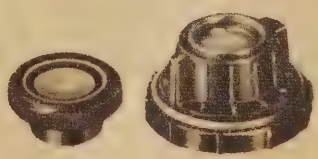


TV chassis, specially made for "R.T.V. and H." 110 and 90 degrees circuits Cadmium plated, and then passivated to avoid fingermarks. Complete with E.H.T. box, and all holes drilled.



nodised metal labels to suit various aymaster amplifiers, control units, id program source. Mono labels, aroon background with silver letterg. Stereo coffee brown and gold. autiful knobs with gold metal centres match.

Q Plus Mark V I.F. strip, ready wired and aligned for the 110 degree TV set. When purchased with tuner, we will supply them matched.
For fringe areas Q Plus Mark III and IV I.F. strips are available.



Set of 5 high-quality TV knobs for 110 degree TV set. In coffee brown or ivory, with attractive gold coloured, trim station numbers on tuning knob.

POST COUPON, write, phone or call for full details of Playmaster Hi-Fi or TV kit. _ _ _ _ _ _ _ _ _ _ _ _

206 BROADWAY, N.S.W. Phones BA4891, BA4892-3
(1st Floor, E.S. & A. Bank Building, opp. Grace Bros.)
A unit of Electronic Parts Pty. Ltd.

Dear Sirs,

Please send me full details of the following (mark square).

☐ *Playmaster Hi-Fi* ☐ *110 degree TV Kit*

Name .....

Address .....

.....

OFF THE RECORD — NEWS & REVIEWS

Having just about satisfied the mono and stereo needs of the audiophile, both immediate and for the foreseeable future, the American radio industry has had to find something new —or sack their saesmen. Needless to say, they have chosen the former course and have presented the said audiophiles with synthetic reverberation.

by **Neville Williams**

THE big trouble, it seems, is that American audiophiles have never been able to afford large enough rooms, in which to enjoy their favourite records.

By making do with two bathrooms and three automobiles, some have managed to get for themselves rooms some 30 or 40 feet wide, but even these are not nearly large enough to let the sound bounce around for the necessary length of time.

It lacks that vital feeling of space.

BASED ON IGNORANCE!

Nor is it any use protesting that records sound pretty good, despite this. Your protestations are based on ignorance; you're in the same case as the native who regards chewed-up betel nuts as the ultimate in fine liqueur.

You've never heard your own records as they should really sound.

To be sure, some contain an element of echo, picked up from the original hall but what do the recording engineers know about such things? They wouldn't know echo effects from reverberation.

And they've as much right to tell you how much echo you should like, as the waiter has to dictate how much sauce (sorry, ketchup) you should put on your meat.

But now let me tell you something! Without sacrificing a single bathroom or a single automobile, without knocking down a single barn to build bigger (Biblical reference, you know) you can have just as much echo as you jolly well like!

How? By the marvel of modern electronics.

Now, see here: You take this little unit with knobs on, and connect it ahead your amplifier, along with your prese control box . . .

Where can you stand it? Oh, you find a place. Talk it over with the litt woman.

Besides, you'll be the first in yo street to have one. The Jones' were here yesterday but they haven't settl yet!

You see, you just turn this knob a the circuits inside create just the amou of echo you want.

This way—no echo!

That way—your living-room is tra formed into a vast echo chamber, like t Town Hall they have "down under," Sidney!

You'll take it? Good! Is one enoug

While I can't swear to the accuracy the foregoing conversation piece, lat trend in the U.S. seems to be a drive sell synthetic reverberation units. Cou ed to existing mono or stereo amplifie they divert part of the original sign delay it for an appropriate time and inject it into the amplifier so that it heard as an echo with controllable d placement and amplitude.

The new units are being advertis in current audio magazines by seve manufacturers.

Philco, Westinghouse, Zenith, Fish and Sargent Rayment are some of t firms who are either already marketi or planning to market reverberati units.

WELL KNOWN PRINCIPLE

Most of the units appear to opera on principles which were developed connection with the Hammond organ produce synthetic echo effects.

A long, narrow box contains a numb of "mechanical delay lines." They lo just like springs, and they would probab serve as such, but length, diameter, pit tension, etc., are discreetly chosen.

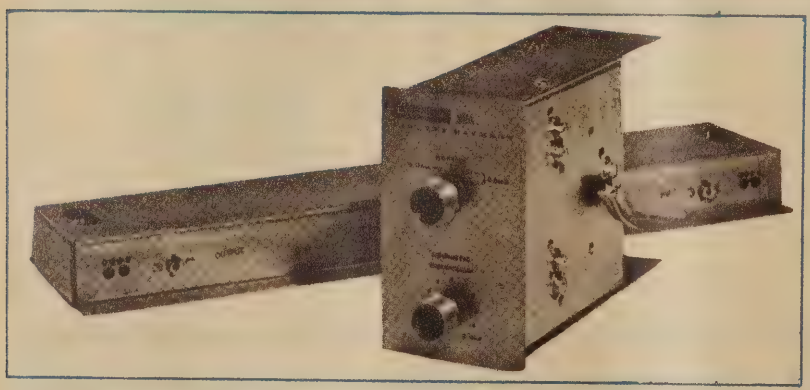
And one end, the springs are attach to tiny ferrite "rotors," mounted insi field windings to which is fed a samp of the audio signal. The ferrites vibra in rotary fashion, proportional to t strength and frequency of the applied s nals and feed the mechanical impulses the springs.

The far ends of the springs are co nected to similar rotors but this ti used as pickup or generator units, who signal can be re-injected into the amp fier chain.

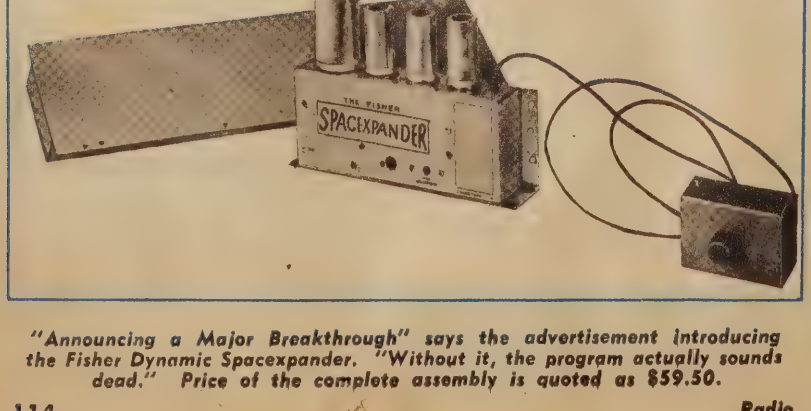
It takes some 30 to 40 millisecon for the signal to traverse typical del lines once but repeated reflections gi a whole series of "echo" signals deca ing in logarithmic fashion.

By selecting different delay lines g ing different orders of delay and by c erating an amplitude control, the "ech signals can be varied to suit, both time and amplitude.

As applied to stereo systems, us



The "Reverbatron" 202, manufactured by Sargent Rayment and offered for $47.75. Modestly, the manufacturers advertise it as "More Sensational Than Stereo . . . and that's an understatement." The box in the foreground houses the controls and valve circuits, the reverberation unit being at the rear.



"Announcing a Major Breakthrough" says the advertisement introducing the Fisher Dynamic Spacexpander. "Without it, the program actually sounds dead." Price of the complete assembly is quoted as $59.50.

ractice seems to be to take a "split" r sample of the two channels, form composite additive signal and apply iis to the reverberation unit. The de-ayed signal is then re-injected into both hannels, adding to the regular left and ght signals which they are carrying.

Another schems, rather more com-lex, adds a reverberation unit to stereo ased on the sum, difference and matrix rinciple.

ADVANTAGE DEBATABLE

For all the attendant publicity, there eems to be considerable reserve mong record critics as to whether ie reverberation units have any real dvantage to offer. While conceding that econd guessing" the recording engin-ers can be good fun for a while, they oresee many possible abuses and mis-nderstandings from the units, particu-irly as, in their extreme settings, they an produce residual echoes with a uration of up to two seconds!

One reviewer reports that any attempt o use more than the barest minimum f added reverberation causes the sound o be "strangely denatured." Transients get lost in a big fuzzy blur," timbre iffers, as also does the stereo effect.

That transients suffer is not altogether urprising.

Regarding "timbre" it is suggested that ie reverberation units "colour" the ound quality because they are highly echanical devices with quite inevit-ble resonance and distortion effects.

The loss of stereo is apparently due the practice of producing a "com-mon" signal and re-inserting it into the stereo channels.

There is a feeling that these objections will only be overcome when and if the mechanical reverberation system is re-placed by some sort of all-electronic delay line, one to each stereo channel.

The trouble is that nobody seems to have been able to devise an all-electronic system with anything like enough delay.

The job could be done, of course, with an endless loop of tape, but this scheme does not appear to have found favour. In fact, one advertiser is eager to point out that his product contains no motors, no tape belts, no complicated drive mechanisms.

UNFAIR TO JUDGE

Perhaps it's completely unfair to judge the principle, personally, without ever having heard it applied, in the manner suggested, to domestic listening, but I can't help feeling that it is basically a gimmick, in the same general class as the Volume Expansion Units of earlier days.

Volume expansion worked wonders for some records, others it ruined, but most of the time, it was just a source of confusion to non-technical listeners.

I rather expect that it will be much the same way with reverberation units—but I mustn't say too much. Technically, they could be quite intriguing and who knows but what we won't some day produce the R., TV and H. Playmaster "Synthecho" Unit.

Come to think of it, I'd better plant a copyright on that name right now.'

A REVIEW OF SACRED RECORDS

"HYMNS OF SALVATION," with Jane Pickens and the Salvation Army Choir. Mono, M.G.M. Variety Series V-02 5003.

Of the fifteen hymns on this record, very one is well known. Included are uch titles as "Abide With Me," "Just s I Am," "Softly And Tenderly," and In The Sweet Bye And Bye."

Jane Pickens, taking the vocal lead, has pleasant soprano voice, and is well upported by the New York Staff Band f the Salvation Army—here doubling s a choir.

The balance throughout is excellent, eing enhanced by some quite throbbing ass from the accompanying organ. As collection of traditional hymns, it akes very pleasant listening, indeed.

Technically, the quality of the disc is ove reproach.

★ ★ ★

"BILLY GRAHAM INTERNATIONAL CRUSADE CHOIRS," with George Beverly Shea and directed by Cliff Barrows. Souvenir Album, Mono, R.C.A., L10929.

I would rate this record as a "must" r anyone with a personal interest in e Billy Graham Crusades.

It brings together, on one disc, rusade Choirs from New York, Glas-w, San Francisco, London, Charlotte J.S.A.), Frankfurt (Germany), Sydney, othenburg (Sweden), Louisville J.S.A.), and Melbourne.

Such a record could easily have been hotch-potch of style and acoustics but und and style are both remarkably nsistent, undoubtedly due to the efforts conductor and director Cliff Barrows.

As it is, the main difference is in the matter of accompaniment, which sometimes involves organ, sometimes piano, occasionally other instruments.

Most of the selections are well known, having been sung by local Crusade choirs. Two I haven't heard before from "Billy Graham sources" is the spontaneous "I'm Glad I'm Singing" (Gothenburg, Sweden), and an impressive "Ev'ry Time I Feel The Spirit" with George Beverly Shea (Charlotte, U.S.A.).

I would rate the disc as technically good, though there is a vague "swish" on my copy which may well be the characteristic of the individual pressing. Be this as it may, it is a record which will get plenty of playing, if I'm any judge.

★ ★ ★

PAUL MICKELSON plays the Conn Classic Organ. Mono, G.F.M. (Gospel Film Ministry), 39-W3056-L.P.

Electronic organ enthusiasts would probably find interest in this disc from the varied sounds of the electronic organ and the degree to which reed tones have been simulated.

My personal reaction was that the organ or the organist — or both — had allowed these tones to dominate the music so much that he might as well have been using a giant harmonium or even, at times, a giant accordion. All too rarely are the pipe voices evident, which would be appropriate to the name "Classic" organ.

Occasionally, too, the "attack" and

The RADIOMASTER

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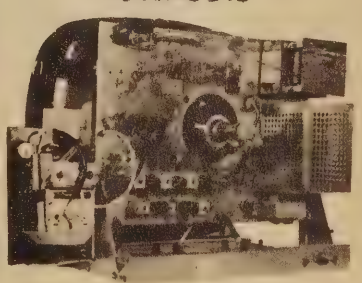

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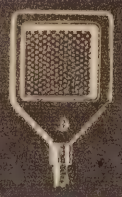

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empo are so fast that we have tunes vith little sense of conviction or dignity.

The selections on the disc include two or three traditional hymns and such equally traditional items as Handel's 'Largo," "Pilgrim's Song Of Hope," and 'Pilgrims' Chorus." It concludes with Sullivan's sacred song, "The Lost Chord."

Technically the disc is cleanly recorded and free of background noise. There s very little life in the upper register, but have no way of knowing whether this as to do with the recording, the mic. placement or the balance of the electronic organ.

★ ★ ★

RONNIE AVALONE with the Concert Orchestra of London, orchestrated by Paul Mickelson. Mono, G.F.M. (Gospel Film Ministry), 27-W3058-L.P.

According to the jacket, Ronnie Avalone began his musical career as a child actor, taking singing parts on Broadway, progressing later to the Metropolitan Opera. Then, quite suddenly, he abandoned his career in the entertainment world and devoted himself to sacred music.

In this record he presents a dozen titles intended to cover a wide gamut of such music, from traditional hymns to the more modern variety; from Negro spirituals to "The Lost Chord" and on to an adaptation from "Il Trovatore."

From start to finish, Avalone remains an "operatic" tenor, with all the characteristic vocal tricks. As such, he has nothing in common with the currently popular gospel singers of the basso-baritone close-mic. variety. Nor can I imagine him appealing to the same audience.

But if you're partial to operatic tenors, your reaction to his voice and his selections might be quite different.

Technically, the recording is of good, average quality.

The sound of Christmas

"CHRISTMAS JOY," George Melachrino and his orchestra, RCA, Mono L10909; Stereo SL10909.

The Christmas theme gives George Melachrino plenty of scope for his taste for elaborate orchestration. Though the Melachrino strings are always ready to take up the theme, there's an abundance of everything else from jingles and bells to a full pipe organ, the latter sounding somewhat gauche in such lighthearted company.

But it's all very sentimental and 'Christmasy," and a suitable counterpart to trees and coloured lights. As to the contents, you'll find a mixture of carols and Santa-sleigh-reindeer songs.

The definition of the stereo copy is superb and, in its class, the disc could well be a hi-fi showpiece except for one fault: On side 2 of my sample copy, the tracks were off centre enough to play havoc with the last track, "Joy To The World." (The fault is being rectified, I understand).

The mono version, while lacking the definition inherent in the stereo, is technically excellent.

★ ★ ★

"CHRISTMAS SURPRISES." From the Ralph Hunter Choir. RCA; Mono L10911; stereo SL-10911.

In case you're wondering as to his identity, Ralph Hunter is Choral Director and Vocal Arranger for stage productions in the Radio City Music Hall, New York.

On side 1, the choir presents a collection of simple "Christmas" songs, with plenty of instrumental and sound effects thrown in. It's all very bright and with an instant appeal to the young — and those who can feel young again on such an occasion.

Some of the traditional carols on side 2 are less successful, to my mind, probably because the tendency to brighten them up has robbed them of their natural simplicity. But, against this, the Indian Carol and the Latin Lullaby are simple—and very effective.

Technically, both mono and stereo versions are excellent, with good definition and no trace of background noise. But, to play them one after the other, provides yet another vivid demonstration of the liveness and atmosphere of good stereo over the equivalent mono.

★ ★ ★

"CHRISTMAS WITH GISELLE," Giselle MacKenzie. Mono, RCA L10919.

Judging by her picture on the cover and by her voice, Gisele MacKenzie is a rather charming lass. Canadian-born, she switches frequently from English to French and sounds equally at ease in either language.

Her voice changes just as completely to suit the song. In a couple of numbers she is virtually indistinguishable from Rosemary Clooney in the latter's more restrained moments. Elsewhere there is no resemblance.

Side 1 contains mainly carols and traditional songs. Side 2 is devoted to Santa Claus, wooden soldiers, jingle bells, and reindeers.

The orchestral backing is bright, varied and appropriate to the themes. A good family disc.

Nor need father have any misgivings about the technical qualities of the record. They are first rate.

★ ★ ★

"THE MERRIEST OF CHRISTMAS POPS." Mimi Hines, The Skip-Jacks, and the orchestras of Esquivel and Ray Martin. Mono, RCA L10910.

The spirit of this disc is pretty well summed up in its title. There are no carols on this one and the dozen Christmas songs have been selected and arranged for merriment rather than sentiment.

Mimi Hines' presentation of "I Saw Mommy Kissing Santa Claus" and "All I Want For Christmas . . . Is My Two Front Teeth," are both good for a laugh. Both orchestras record well, with Esquivel making his usual unusual noises. Good for parties this one.

The quality? Once again, first rate.

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Billed as "the most expensive radiogram ever to be released in Australia," the "La Scala" super-gram is now being marketed by Philips Electrical Industries. The retail price is quoted as 750 guineas.

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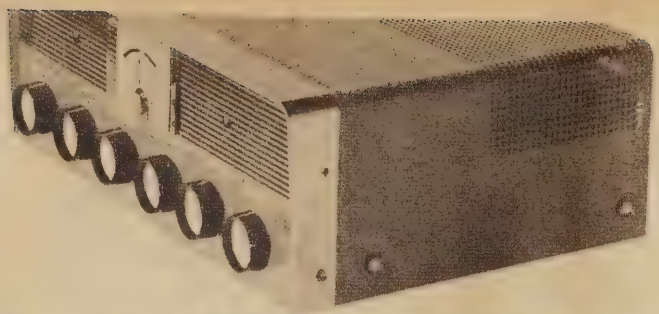
Circuit specifications indicate the use of 23 valves and one diode, a power output of 20 watts per channel at an overall distortion of less than 1 per cent. It has built-in antennas and extension speaker facilities to extend the spread of the stereo, as desired.



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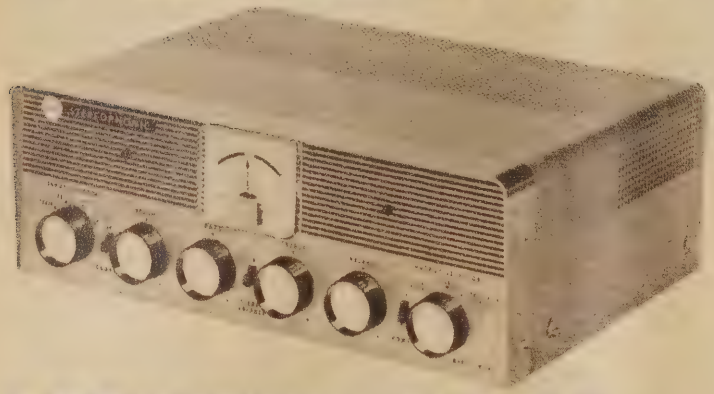

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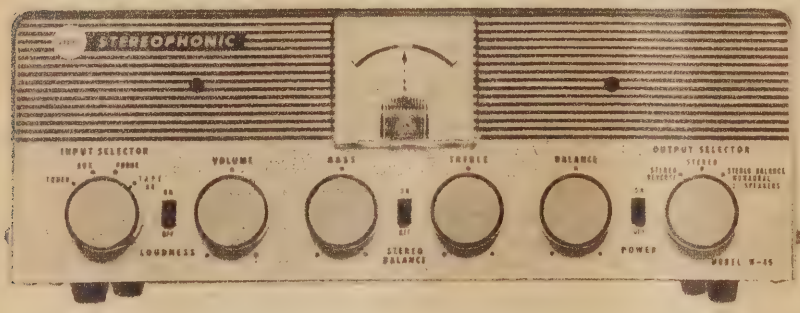

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★ ★ ★

"HARK, THE STARS OF HOLLYWOOD SING," The Voices of Christmas, with Les Brown and his Band. Mono, Coral CL-7654.

I fancy that there could be a more fortunate title than this parody on a Christmas carol.

In fact, it is a recording of a charity concert at the Beverly Hills Hotel, aimed at assisting more U.S. hospitals to install cardioscope equipment. Among those in attendance are listed Dolores and Bob Hope, June Hutton and Axel Stordahl.

Much vigorous clapping punctuates the items and carol singing and I have no doubt that a good time was had by all. Whether you'll have the same will depend on your reaction to community singing, irrespective of the fact that the audience, in this case, is more distinguished than usual.

I can't rave about the technical quality. The acoustics of the auditorium aren't the best and one of the numbers on side 1 suffers what sounds like an accident to the speed of the original tape.

★ ★ ★

"MANTOVANI CHRISTMAS ALBUM." Mantovani and His Orchestra. Mono, Decca LKA 4235.

Mantovani fans will certainly not be disappointed in this collection of Christmas carols. "The Mantovani sound is rich and satisfying," say the cover notes; "The fine melodies are placed once and for all time on a rich cushion of sound."

That just about sums it up. The old traditional tunes undergo a lot of arrangement and orchestration, but they make pretty impressive sound in the Mantovani manner.

Technically, the disc is excellent, with not a trace of distortion or noise and with the response necessary to show up the massed violins to advantage.

★ ★ ★

"CHRISTMAS CAROLS," Billy Vaughn and His Orchestra. Mono, London HAA 2195.

Billy Vaughn follows the same formula as Mantovani, reviewed above. He presents much the same collection of carols, with a couple of Christmas songs thrown in. He embarks on the same order of arrangement and orchestration, but with emphasis on instruments which are blown into rather than scratched upon.

I didn't like the result quite as well as the Mantovani, though it suffers mainly as a result of direct comparison.

Technically, the disc isn't quite up to the same standard either, though I doubt that the differences would show up on anything but very wide-range equipment. But if you do have such equipment, you will hear a very deep tape hum behind each number, disappearing during the breaks.

★ ★ ★

"WHITE CHRISTMAS." Sung by Pat Boone. Stereo, London SAHA 7514.

One gains the impression that Pat Boone felt completely at home while making this, his latest release. He sings smoothly, easily and with expression appropriate to the particular number, his style varying from reverent to gay.

Nine of the fourteen numbers are familiar carols, the other five equally familiar Christmas songs. In this respect, the

ord differs little from several others viewed above, and the choice will be e of artist rather than content.
The surface of the pressing is dead iet and the quality clean, with general balance drawing attention, if ything to the extreme trebles.

★ ★ ★

"MUSIC OF THE MEDIEVAL COURT AND COUNTRY-SIDE" (For the Christmas Season). New York Pro Musica Antique, directed by Noah Greenberg. Mono, Festival, FL-7185.

In completely different character is s study of Medieval Christmas music vering the periods between the twelfth d the sixteenth centuries.
Then, as now, Christmas brought to- ther festivity and deep religious devo- n, and the music points the fact. Dance d devotion, Latin and vernacular, ant and instrument all made obvious ntribution to the Christmas music of e age.
Students of music should find much profit and entertainment in this disc, ong with the detailed cover notes and ronoed booklet which is supplied as ll.
The contents are partly vocal, partly strumental, but the whole is notable for precision in presentation.
The quality of recording is generally od.

IN VARIED MOOD

"CAN-CAN" (Cole Porter), with Frank Sinatra, Shirley MacLaine, Maurice Chevalier and Louis Jourdan. Stereo, Capitol SW1301.

There's plenty of life and verve in is "original soundtrack" recording from Can-Can," per Twentieth Century Fox, hich differs somewhat from the original le Porter score.
The twelve tracks contain ten song s, featuring the artists as listed, and o selections from the orchestra under elson Riddle.
Throughout, the orchestra records par- ularly well, the stereo lending spread, thout being otherwise exploited. The chestral selections themselves provide od hi-fi listening.
Overall, the vocals aren't quite as suc- ssful. There is no doubt about bal- ce and diction, but, here and there, e voices have a slight "edge," which ight indicate that the mechanics of the cording system are being pushed to e limit.
But only dyed-in-the-wool hi-fi fans e likely to quibble about this. If you e the music, you'll certainly enjoy the cord.

★ ★ ★

"PAINT YOUR WAGON," with James Barton, Olga San Juan and Tony Bavaar, orchestra and chorus conducted by Franz Allers. Mono, R.C.A. L10868.

In the style of a musical comedy, erner and Loewe populate a western ining centre with some remarkably phisticated hicks and an even more phisticated chorus and orchestra.
If you don't mind this sort of thing, owever, you'll find plenty of bright usic on this disc of "Paint Your agon."
But, over and above the musical con- nt, the disc is quite impressive for its chnical qualities. For a mono record- ing, the definition of the orchestra and the "presence" of solo voice and instrument is outstanding. Nor is there the slightest trace of background noise.
Just occasionally the amplitude on voice goes beyond the bounds of prudence, but the rest is so good that one can forgive the occasional aberration.

★ ★ ★

"LOVE IS A MANY SPLENDOURED THING," Hollywood Film Music played by Victor Silvester and his Silver Strings. Mono, Columbia 330SX 1230.

Victor Silvester pays his tribute to Hollywood with 15 hit tunes, played in his characteristic strict tempo, and making for pleasant listening or pleasant dancing —whichever be your inclination.
You'll probably want most to know the titles, which are as follows, with my further abbreviations: "Many Splendoured Thing" (SFT); "Laura" (SFT); "All Of You" (QS); "Old Black Magic" (R); "Around The World" (W); "Moulin Rouge" (W); "My Foolish Heart" (SFT); "It Can't Be Wrong" (SFT); "Moonglow" (SFT); "Picnic" (SFT); "As Time Goes By" (SFT); "Gal In Calico" (QS); "Sand In My Shoes" (R); "Eternally" (W); "Diane" (W); "Goodnight My Love" (SFT).
The orchestral definition is excellent in some of the numbers, just average in others, but the reproduction generally is clean and the surface quiet.

★ ★ ★

"FAVOURITE SHOW TUNES," Volume 2, featuring the Sorkin Strings. Stereo, Concert-Disc CS37/20.

Ten popular tunes are featured on this disc, including "When You Wish Upon A Star," "Zing Went The Strings Of My Heart," "Over The Rainbow," and "Oh, What A Beautiful Morning."
The Sorkin Strings make no attempt to emulate the massive cascading sounds of Mantovani and others. They are a smaller "busy" group, maintaining a lively tempo and with rapid melodic changes.
The surface of the disc is quiet and the reproduction clean but with just the vaguest suggestion of an "edge" to the strings that isn't quite natural. The stereo is used rather more conservatively than is usual with this label. The spread is quite definite, but there is little attempt to play one channel against the other.

★ ★ ★

"YOU MUST HAVE BEEN A BEAUTIFUL BABY." Sung by "The Crew-cuts" and produced by Herman Diaz, Jnr. Mono, RCA L 10872.

The dozen songs on this disc all refer directly, or by inference, to "babies." Not to the recently born of the human species but to attractive young women, otherwise known colloquially as "babes" or "dolls."
By way of illustration, I quote "Baby Face," "Pretty Baby," "When My Baby Smiles At Me" and such like.
The Crew-cuts, a typical male harmony trio, don't seem to tire of their subject, though their listeners might, if it were not for the timely variations in tempo and rhythm accompaniment.
But then I'm getting past my "baby" days.
Of one thing I'm certain. If you want to hear what the Crew-cuts have to say about babies, there'll be nothing to mar the pleasure. The recording's fine!

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Thorens Tone Arms: complete with lifting device, 5-pin plug-in shells, wired for stereo, will accept all cartridges, tracks down to 2 grams. **£7/10/.**

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IN REVIEW—By JULIAN RUSSELL

NEW PETROUCHKA—ENJOYABLE

Stravinsky—Petrouchka. Complete ballet. Played by the Boston Symphony Orchestra conducted by Pierre Monteux. RCA Stereo SL-16245. Mono, L16245.

Several first-class performances of Petrouchka are available, most of them on mono, but this is, to me, the most enjoyable issued to date. Unhampered by the exigencies of accompanying a ballet troupe, Monteux can vary his tempos in a way that would be impossible if dancers had to fit steps to the music.

As a result, the second scene, in Petrouchka's cell, has a tragic tenderness seldom heard in a theatre, and the doll's entrance doesn't produce the customary frantic outburst.

Few ballets can be translated to the concert hall with the effectiveness of this one and Monteux takes full advantage of his freedom to give what is a definitive account of the brilliant score. The stereo has rather more separation than is found in European recordings, but the channels never nudge the attention from one to the other.

The Boston is at its brilliant best, its soloists playing with the assurance of those long familiar with the score, the ensemble faultless in attack and release. The open trombones in the Moor's scene really crackle, Petrouchka's muted trumpets glitter like spangles, and the vitality of the pulse in the Russian dance makes even the most sluggish feet want to tap out the time to the music.

The mono version is also most efficiently engineered, though such effects as the antiphonal spacing of the brass on Petrouchka's entrance in the third scene never acquire the spaciousness of the stereo pressing.

★ ★ ★

Franck — Symphonic Variations for Piano and Orchestra. D'Indy—Symphony on a French Mountain Air for Orchestra and Piano. Played by Robert Casadesus and the Philadelphia Orchestra conducted by Eugene Ormandy. Coronet Stereo KLCS — 2705. Mono KLC — 2705.

Admirably spread sound keeps Casadesus' rather light-toned piano satisfactorily stable against the rich background of the Philadelphia at its most opulent. The few solemn bars of the introduction behind him, the soloist embarks on a reading full of poetry that lacks nothing of vigour whenever it is required.

The balance is always perfect, soloist and conductor giving each other plenty of elbow-room in the right places. One passage features what is perhaps the most impressive diminuendo I have ever heard on disc, and the climaxes are all massive enough to please those who seek a wide dynamic range.

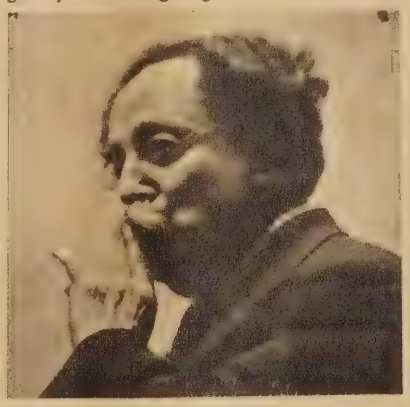
The balance is subtly different in the d'Indy, where the piano is used by the composer as an orchestral instrument and not as a medium for virtuoso display, though the part requires a virtuoso technique to do it justice. I have never heard the opening orchestral bars more expressively phrased, and these set the standard for a beautifully organised performance by both soloist and orchestra.

The banjo-like opening of the finale has a quite wonderful twang which is intended, of course, to be heard that way and is not the result of distortion. Although this critic has sat through the work countless times, in this version he never tires of listening to what was probably the only song the old mountaineer ever learned. Only the stereo version was available for review. A memorable disc.

★ ★ ★

Respighi—Feste Romane. Symphonic Poem. Played by the London Symphony Orchestra, conducted by Sir Eugene Goossens. Top Rank Mono. TRC-1020.

Playing and engineering are excellent in this seldom-heard work of Respighi, the brilliant scoring lending itself admirably to modern recording techniques. Unorthodox sounds from mandolines, rattles, lurching drunken trombones, and other exotica emerge with brilliant clarity and the more conventional instruments give just the right glitter to this vividly pictorial music. The big bell used sounds surprisingly like a real one and not a tubular substitute.



Pierre Monteux, the Boston Symphony Orchestra and "Petrouchka."

The suite consists of four movements, Circus Maximus, Jubilee, October Excursion, and Epiphany, but even given as they are here, without cuts, the playing-time is a little on the short side. This having been said, I have nothing but praise for the other features of the disc.

★ ★ ★

Dvorak—Concerto for Cello and Orchestra in B Minor, Op. 104. Played by Mstislav Rostropovitch and the Royal Philharmonic Orcestra conducted by Sir Adrian Boult. HMV Mono OALP1595.

If you are prepared to ignore a few minor blemishes, most of them in the first movement, here is a ravishing performance of this great concerto. The balance is a little capricious on the soloist's entrance and his instrument woofs now and again until he settles down.

But these forgotten, I have listened to the disc many times with unmixed joy since I acquired it. Rostropovitch combines a peerless technique with a musical intelligence of the highest order. His emotional range encompasses passion, gaiety and regret with unfaltering good taste. It is obvious that he prepared the most insignificant bars of his part with the same care he expended on its showiest aspects.

Boult, too, his rather tentative opening bars behind him, goes on to supply an accompaniment that is at once sensitive yet never mock-modest. At times his strings tend to be overshadowed by the rest of the orchestra in the fortissimo tuttis, a fault which might have been corrected in a stereo version which, unfortunately, the makers do not contemplate issuing.

As I stated earlier, the disc is not without minor shortcomings, but its breathcatching beauty brought this listener to the verge of tears when he first heard it.

★ ★ ★

Monteverdi—Selected Works. Nadio Boulanger conducting Vocal and Instrumental Ensembles. The Record Society. Mono 6001.

Nadio Boulanger has gone to such pains to offer an authentic performance of these 16-17th century pieces that her use of a modern piano for the continuo will puzzle most students of the period. Otherwise the whole production is a delight, the performance immaculate, and the music exquisite in shape and content.

The distinguished format in which the disc is presented includes interesting information about this great, but till recently, neglected composer, and translations of the texts, together with the original Italian, of the works performed.

They consist of madrigals, chaconnes and other pieces for vocal and instrumental ensembles, and though first recorded in 1937, have been transferred to LP with great skill.

★ ★ ★

Puccini—La Boheme, Complete Opera. Tebaldi (Mimi), Bergonzi (Rudolfo), Bastianini (Marcello), Siepi (Colline), d'Angelo (Musetta), Cesari (Schanuard). The Chorus and Orchestra of the Santa Cecilia Academy conducted by Serafin. Decca Stereo SXLA2170/1. Mono LXTA5542/3.

The first stereo, La Bohema, to come on the local market is impressive. Some of the scenes put it into the very top rank of modern recordings.

These include a wonderfully vivid second act with a brilliant ensemble recreating in your sitting-room all the bustle and excitement of the Montmartre street- scene as you might enjoy

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in an opera house. The third act, o, opens with a beautifully evocative chestra painting a picture of a chilly awn on the outskirts of Paris.

These, of course, are highlights, but sewhere, except in an occasional spot, ie engineering is as fine as you'd hear nywhere today. One of the failures is ie first act ending, where the voices, ipposed to be moving slowly off-stage, iminish with quite unrealistic speed and it off with clumsy suddenness, though t the end of the third act, where much ie same effect is sought, is much bet- r managed.

Serafin's tempos tend ever so slightly t times to the deliberate, though the one of his orchestra always remains ichly expressive. Lacking is just that ouch of rapture that made Beecham's ono recording of four years ago so rilling an experience.

The principals offer much lovely sing- ng, with Tebaldi at the top of her form, nd Bergonzi partnering her with an rdour that never oversteps the confines f impeccable taste—an unusual virtue in talian tenors of this generation. Strange- y, Gianna d'Angelo's voice sounds a ood deal lighter in the stereo version han in the mono, the effect in the stereo eing to endow Tebaldi's Mimi, by con- rast, with a trifle more than the desir- ble amount of maturity.

The remaining three Bohemians are ine and the balance between singers and rchestra, especially in the ensemble umbers, wholly satisfactory. There is, hroughout, the tiniest tendency to over- esonance that characterises so many nodern recordings, giving the ear the mpression that the work was recorded n an empty theatre.

I would stress, however, that these are only trifling defects that can be easily gnored by all but the most hypercritical isteners. My own preference remains with Beecham's dawn-fresh reading, but here is, I am informed, no chance of his version being re-issued in stereo. That being the case, the present set has my enthusiastic recommendation.

★ ★ ★

Mozart—Piano Sonatas No. 5 in G (K. 283); No. 13 in B Flat (K. 333). Rondo in A Minor (K. 511). Played by Wanda Landowska. RCA Mono L16242.

As the world's greatest harpsichordist of her age, Wanda Landowska's style was characterised by great clarity of articulation in even the fastest passages and a faultless sense of style. These features dominate her playing of a modern piano in the disc under review, but here they may not meet with the unqualified approval that rewarded her harpsichord playing.

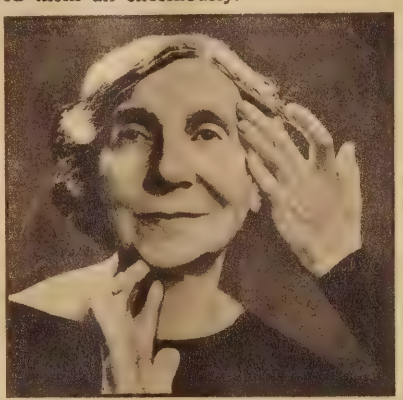
They tend to give her performance a chastity that sometimes perilously approaches primness. The emotional range seem unduly restricted, especially in the slow movements, one of which lasts for more than 13 minutes. In the faster ones this pallor is not so evident. But there is no denying the exquisite precision of her technique nor the refinement of her musical intelligence.

★ ★ ★

Handel — Organ Concertos — Volume 1, Op. 4, Nos. 1, 2, 3, 4. Played by Karl Richter and the Karl Richter Chamber Orchestra, directed by Karl Richter. Decca Stereo SXLA 2115. Mono LXTA5578. Volume 2. Op. 4, Nos. 5, 6, Op. 7, Nos. 1 and 2. Played by the same artists. Decca Stereo SXLA2187. Mono LXTA5579.

Much scholarship has been expended during recent years on examining the stylistic peculiarities of 18th century music, especially the ornamentation that many composers of the period left to the discretion of the performers. Those who have studied these aspects of the music profess scorn for performers who ignore the results of their industry.

I am, therefore, afraid that enthusiasts for Handelian purity of style will find much to disapprove of in Richter's omission of ornamentation in some of these sonatas. The present writer, however, who is not, at least at present, plagued with a stylistic conscience about these matters, confesses to having enjoyed them all enormously.



Wanda Landowska—"world's greatest harpsichordist of her age."

Richter uses a delicious toned baroque organ—in Mark's Church, Munich—with a technique of the utmost dexterity enlivened by a sense of rhythm rare indeed in organists. He manages, too, to maintain enviable precision of ensemble while conducting his chamber orchestra with a superb sense of balance, from the organ console.

Those who have heard only the gigantic organs built during the last century will be surprised, and I hope, delighted, at the delicious sounds Richter evokes from his modest instrument. And they might be equally surprised at the unending stream of magnificent melodies that Handel strews so lavishly through these nowadays neglected works.

The engineering of both the mono and stereo versions of these discs, which I recommend with the greatest enthusiasm, is consistently first rate.

★ ★ ★

Schubert—Quintet in A Major, Op. 114 (The Trout). Played by members of the Fine Arts Quartet —Sorkin (violin), Ilmer (viola), Sopkin (cello), with Glazer (piano) and Siegel (double-bass). Concert-Disc Stereos, CS-206/24.

A highly efficient performance with a refreshingly modest double-bass for a change. The extremely wide dynamic range might give some listeners the impression that it all sounds rather larger than life size. A slight tendency to over-separation can be corrected by placing the speakers no more than six feet apart.

I feel, however, that a work as popular as "The Trout" might well find still more satisfactory presentation in the near future, though, if you are in a hurry to acquire one, this will do nicely in the meantime.

★ ★ ★

Verdi — Rigoletto. Complete Opera slightly abridged. Tucker (The Duke); Capecchi (Rigoletto); D'Angelo (Gilda); Sardi (Sparafucile); Pirazzini (Maddalena); Cattelani (Giovanna); Susca (Monterone). Chorus and Orchestra of the San Carlo Opera, Naples, conducted by Francesco Molinari-Pradelli. Philips Mono A-02021/2-L.

The sound is good throughout this set which omits only small passages of the score to get it on to two 12-inch discs, though this economy is achieved at the expense of a couple of awkward turnovers. Its chief drawback is in the balance which often pushes the orchestra into the background and brings the singers uncomfortably close.

This is a pity because, given a chance to be heard, the conductor handles both orchestra and chorus with fine authority and a feeling for drama that is refreshingly free from operatic cliches. His management of the abduction ensemble and the pianissimo "Zitti" chorus is superbly sensitive, for instance, but the oppressive presence of the singers quite swamps him elsewhere.

Tucker makes a useful, ardent Duke of bigger stature than is customary, an effort perhaps caused by his proximity to the microphone. The Gilda sings with commendable correctness and notable agility in coloratura phrases but both her voice and personality are a little too cool to charm one unreservedly.

A tendency to force his voice in the more expressive bars causes some unevenness in Capecchi's otherwise highly competent account of the title role. The smaller parts are all competently handled. I prefer, however, the R.C.A. set reviewed in this column last month.

★ ★ ★

Beethoven—Symphony No. 7 in A Major, Op. 92. Played by the Royal Philharmonic Orchestra conducted by Sir Thomas Beecham. HMV Mono ALP1748.

Wild-catting tempos make this a very curious reading indeed. The most satisfactory movement in an otherwise disappointing performance is the Allegretto, which opens in an atmosphere of rare beauty and then deteriorates to what approaches perilously close to bathos.

The first movement, taken at break-neck speed, is rhythmically without interest and the bacchanalian finale suffers from the same treatment. The engineering has the prevailing tendency of some labels—nearly all, in fact—to award the woodwind more than their proper share of the limelight.

★ ★ ★

Beethoven—Symphony No. 6 in F Major, Op. 68 (Pastoral). Played by the Vienna State Opera Orchestra conducted by Hermann Scherchen. Westminster Stereo WG-W-18077.

This, too, is disappointing. Perhaps in an effort to emphasise the difference between the first two movements, which can, at times, be made to resemble each other too closely, Scherchen gallops through the first at a ridiculous pace.

The second goes more orthodoxly, but

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even here the conductor seems loth to give the music time to speak for itself. The sound is below average.

Beethoven — Mass in C Major. Royal Philharmonic Orchestra and Beecham Choral Society conducted by Sir Thomas Beecham. World Record Club Stereo TE223.

Beecham is much more "respectable" in this work which many musicians disparage—quite unjustly, to this writer's way of thinking. It may not all be vintage Beethoven, but it contains much music of great nobility.

The soloists are Jennifer Vyvyan, Monica Sinclair, Richard Lewis and Marion Nowakowski, a splendid team that responds generously to the conductor's not easily satisfied demands. The chorus, too, is fine, both in discipline and tone, and the stereo distribution extremely well handled. Beecham deploys his large forces with unquestionable authority.

★ ★ ★

Beethoven—Symphony No. 5 in C Minor, Op. 67. Coriolan Overture, Op. 62. Played by the Chicago Symphony Orchestra conducted by Fritz Reiner. RCA Stereo SL16244.

This is Beethoven played in the grand manner, vital with controlled energy, alert to sensitive inflections, masculine without being dogmatic, each movement presented with a perfect sense of proportion for the whole.

The splendid engineering has a wide, but not unwieldy dynamic range, and the stereo is beautifully distributed between the two channels. The orchestral tone is rich but never too opulent. I can recommend it without any qualifications whatever. And the Fifth is coupled with an amply dramatic account of the Coriolan Overture for good measure.

★ ★ ★

Beethoven—Symphony No. 4 in B Flat Major, Op. 60. Coriolan Overture, Op. 62. Played by the Orchestra of the Suisse Romande conducted by Ernest Ansermet. Decca Stereo SXLA 2116. Mono XLTA 5507.

A surprisingly good performance coming from a conductor and orchestra who specialise in French and contemporary music. Ansermet's reading is neither precious nor miniature, but of full-sized symphonic stature enlivened by freshness of approach throughout.

He avoids the vehement assertions of the German school yet never leaves a point unmade. Some occasional rhythmic indecision may momentarily worry a few hypercritical listeners, but ample compensation is provided by the general sensitivity of the treatment elsewhere.

The stereo version tends ever so slightly to push out the bass on a normal setting of the controls, a characteristic which disappears in the mono, which however, acquires a slight wiriness in the strings that is absent from the two-channel version.

RECOMMENDED

Tchaikowsky—Symphony No. 5 in E Minor. Concertgebouw Orchestra conducted by van Kempen.

Beethoven—Symphony No. 7 in A Major. Berlin Philharmonic Orchestra conducted by van Kempen. Fidelio Overture. Hague Philharmonic Orchestra conducted by van Otterloo.

Puccini—Tosca Highlights. Stella, Poggi, Taddei and Chorus and Orchestra of San Carlo Opera, Naples, conducted by Serafin.

Liszt—E Flat Piano Concerto. Cor de Groot and the Hilversum Radio Philharmonic Orchestra conducted by van Otterloo. **A Major Piano Concerto.** Cor de Groot and Hague Philharmonic Orchestra conducted by van Otterloo.

Mascagni — Cavalleria Rusticana highlights. Pagliacci Highlights. Poggi, Mancini, Cattellani. Protti and Beltramo, and Chorus and Orchestra of San Carlo Opera, Naples, conducted by Ugo Rapalo.

★ ★ ★

Liszt—Les Preludes, Mazeppa. Hague Philharmonic Orchestra, conducted by van Otterloo. **Hungarian Rhapsody No. 2.** Vienna Symphony Orchestra, conducted by Wilhelm Lorner. **Hungaria.** Hague Philharmonic Orchestra conducted by van Otterloo.

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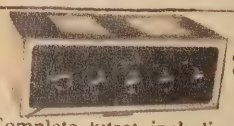

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7 Valve, 20 watt, **£22/17/6**
100-watt **£63**

Battery Operation

6 valve 6v, 10 w **£18/15/**
7 valve, 12v. 12 watt, **£19/15/**
7 valve, 12v. 25 watt, **£24/17/6**

BATTERY-AC OPERATION

6 valve 6 x 240 10 watt, **£20/15/**
7 valve 12 x 240 12 watt, **£21/15/**
7 valve 12 x 240 25 watt, **£29/7/6**

New Transporter 7

With RF stage.
Using drift type transistors.
Improved range and performance.
KITSET **£25/17/6**
Wired and tested . . **£29/7/6**

LEADER Signal Generator

240v. AC power.
6 band. Accuracy 1 p.c.
120 Kc to 270 megs.
£19/15/0
Post, N.S.W., 7/6; Int., 10/.

MULTIMETER

20,000 O.P.V. sensitivity.
Ranges:
DC volts, 0, 10, 50, 250, 500, 1000.
AC volts, 0, 10, 50, 250, 500, 1000.
DC current 0.50uA, 0.25, 0.500mA.
Resistance, 0.50K, 0.05 meg, 0.5 meg.
D.B. minus 20 to plus 36.
£9/5/0

MODEL K.2

2000 O.P.V. Sensitivity: Ranges as above except 50uA.
£6/12/6
Post, N.S.W., 3/6; Int., 5/6.

METERS

Flush mounting.
2½" moving coil. 1mA.
£2/5/0
0 to 50uA.
£4/15/0

STEREO PLAYER

4-speed.
£10/17/6
Stereo Changers, 4-speed,
£14/17/6

RECORDING TAPE

Hi-coercivity tape, ex A.B.C. Stations.
1,200ft spools **£1/7/6**
600ft spools **19/6**

TV ANTENNAE

A Complete Range from
£4/15/-

A.E. RADIO

PHONE LA 3845

136 VICTORIA RD. MARRICKVILLE, SYDNEY, N.S.W

AND 636 KING STREET, NEWTOWN — LA7008

EVENINGS and WEEKENDS: "KALUA," Hilma Street, Collaroy Plateau, XW5956

DULWICH HILL, UNDERCLIFFE, EARLWOOD BUS AT DOOR, STOP No. 42

AR8 Communications Receivers

12 valve. Converted to 240v A.C. Thoroughly Tested. Re-aligned. Latest Ovaltone Permag Speaker

£34/17/6

NEW VALVES

12C8	12/6	1629	10/
VT501	12/6	1619	£1
211	17/6	RK75	10/
1C6	12/6	VR75/30	15/
1J6	12/6	RK48A	£3
3A4	15/	954	7/6
3B7	10/	VR105/30	15/
3D6	10/	6AC7	5/
304TH	£1/10/	EL3NG	12/6
2050	£1	2X2-879	5/
6AM6	17/6	6AJ5	9/6
1K7	5/-	VR150/30	15/
1M5	5/	6AK5	17/6
6X4	12/6	9006	5/
6J5	9/6	6AS7	12/6
9003	12/6	6A8	17/6
6J6	15/	CK1013	15/
6J7G	7/6	6SA7	15/
6N7	10/	6SL7	15/
KTW62/6U7	7/6	6AB7	12/6
1D5	7/6	EF39	12/6
6F6	12/6	EK32	15/
EF37	12/6	EBC33	12/6
6X5	10/	809	9/6
6V6	12/6	100TH	19/6
12K8	12/6	6AG5	9/6
1T4	10/	7F7	12/6
1P5	7/6	EL91	10/
6AG7	15/	EF73	10/
VT502	12/6	EF72	10/
1L4	5/	EC70	10/
6K6	7/6	V90/30	15/
AV11	3/9	IF5	7/6
6K7	5/	2A3	10/
12SJ7	12/6	807	£1/-/-
12SL7	12/6	6L6	£1/-/-
6SH7	7/6	2C26	7/6
47	12/6	RK34	7/6
843	£1/10/	1N5	7/6
957	10/6	1C7	2/6
1625	£1	1M5	5/

ROLA NEW 7x5 SPEAKERS

£1-9-6

Post, N.S.W., 3/6; Interstate 6/-.

NEW C.R.O. TUBES

2API	£1/2/6
3API-906	£1/7/6
5BPI	£1/17/6
CV1957	9/6
CV112	10/
VCR138	17/6
5LPI	£2/17/6
VCR97	£1/17/6
5FP7	17/6
3FP7	7/6
CV322	7/6
VCR511B	£1/7/6

NEW POWER TRANSFORMERS

240v A.C. 50 cycle primaries. Standard 6.3 filaments.

300 x 300v 40mA	19/6
1960 5" CRO	£5/10/
1960 3" CRO	£3/15/
60mA 385 x 385 vert.	£1/2/6
325 x 325v 150mA	£3/17/6
250 x 250v 180mA	£3/17/6
295 x 295 300mA TV	£6/15/
115v 700mA TV	£4/17/6
750 x 750v 750mA	£7/10/
240v to 6v or 12v 1 amp	12/6

Vibrator Power Transformers

6V 135V 35mA	£0 19 6
6V 300V 125mA	£3 17 6
12V 325V 125mA	£3 17 6

Inverter Transformers

6V 240V 40 Watt	£3 7 6
12V 240V 60 Watt	£3 7 6
32V 240V 60 Watt	£3 7 6
12V 240V 100 Watt	£4 5 0
32V 240V 100 Watt	£4 5 0

RELAYS

6V. 3-pole Miniature	15/
1700 SPDT	7/6
1300 SPDT	7/6
500 x 500 SPDT	7/6
12 volts DPDT. 5 amp	£1
12 volts DPDT	12/6
100pf TX var. condensers	10/
100 to 500pf 3000v. var.	10/
500 to 2500pf 750v. var.	10/
Hi-speed Polarised relay	£2/10/
400 ohm	12/6
6v. Type 3000	7/6

Hi-lo Phono Transformers	4/6
Hi-voltage. Lead-thru Insulators each: 15/ doz.	1/6
Multi-strand 4-core Cable.	yard 1/
60pf with Vernier	£1/1/
30 pf	10/
Throat mikes, new	3/6

OIL FILLED CONDENSERS

.5mfd 600V	3/6
2mfd 600V	6/6
1mfd 600V	6/6
4mfd 600V	6/6
4mfd 2.5K	£1/10/
2mfd 2K	15/
.5mfd 5K .1 5K, .1 3K AC .25 4K	15/ ea.

TRANSFORMERS

240v-110v. 1,000 watt Projector Transformers.

£8-10-0

GENEMOTORS

Input	Output			
24v.	250v. 100mA	£1	0	0
24v.	550v. 375mA	£2	0	0
24v.	250v. 60mA	£1	5	0
12v.	500v. 350mA	£8	10	0
12v.	1200v. 100mA	£6	10	0
24v.	250v. 100mA. New	£2	0	0
12v.	235v. 50mA	£2	15	0
12v.	350v. 50mA	£2	15	0
24v.	540v. 200mA New	£2	15	0
24.v	300v. 250mA New	£2	15	0
12v.	275v. 110mA	£3	15	0
12v.	300v. 250mA New	£2/15/		

New Vacuum Pumps

27lb pressure. 7 cu. ft per minute.

£2/17/6 Post 7/6

TELEPHONES

TYPE F MAGNETO

Table Model.

Long Range — Tested.

Perfect Order.

£3/19/6

Cable to suit, new, 1-mile. drums, £1/7/6

V.H.F. TRANSMITTING VALVES

New. Current. Not war-time manufacture.

832A-QQ/04/15

19/6

4/125A—4D21—QY3/125

£4/15/- EA.

GENEMOTOR SPECIAL

28-32v. 300v. 250mA. Will operate TV sets.

£1-7-6

New Coils and Intermediates

Standard or miniature to suit all valves

Coils B/C. 455 KC	9/6
Coils S/W, 455 KC	9/6
Inters	11/6
Loop aerial coils	9/6
Slug tuned H.F. coils to suit 44 mcs.	4/6

28-32V VIBRATOR POWER SUPPLIES

Regulated 150v. output.

£1-17-6

NEW TRANSMITTER POWER SUPPLIES

240v., 50 cycle. 1200v., 500mA; 275v. 200mA. 6.3v. 12 amp. DC. Fully filtered.

£19-17-6

WANTED

Communications Receivers. Test equipment. P.A. Gear. Large or Small surplus stock. Best prices. Call, write or phone any time.

DYNAMIC HEADPHONES

Low impedance **17/6**

Postage 2/6.

Dynamic microphones, type 7, 12/6 Postage 2/.

No. 19 TRANSCEIVERS

Complete with 15 valves and power supply.

£12/17/6

P.A. SPEAKER UNITS

P.A.7. New condition

£7/10/- EA.

With short aluminium Horn and Line Transformer.

£8/10/-

ARR2 RECEIVERS

12v Operation. 11 Valves. 3-6AK5 7-9001 12-A6 V.H.F 234-259 Mcs. Plus 6 Channels. Broadcast and double conversion. New condition. Including Valves and Circuit.

£7/17/6

NEW ROTARY CONVERTERS

160 watt. 50 Cycle. 24v to 32v input. Output can be supplied for 50-110 or 240v as required. Suit radiograms, TV, tape recorders, fluorescent lights.

£19/17/6

240V A.C.

TYPE S POWER SUPPLIES

As used for AR8-AT5 Stations 575V 350mA plus 250V, 100mA Plus 12V DC 10amp. Tested New Condition

£18/17/6

MINE DETECTORS

Ideal for tracing water pipes, locating metals, etc.

£5-17-6

522 TRANSCEIVERS

Complete with Valves. Excellent Condition.

£12/10/-

522 Receivers. Complete with Valves **£5/17/6**

522 Transmitters. Complete with Valves **£7/15/-**

LIGHTING PLANTS

12v. 300 watt. Direct coupled to 1 h.p. petrol engine. Tested. Perfect order.

£36/10/-

115v D.C. 2½ amp. As above. New. £29/10/.

AIRCRAFT GENERATORS

24V. 50AMP £5/15/
28V. 100AMP. £12/17/6.
28V. 60AMP. £10/10/-.

1154 TRANSMITTERS

100 watt output. Complete with Valves and meters, £4/17/6.

AT5 TRANSMITTERS

Complete with Valves, £5/17/6.

NEW POTENTIOMETERS

2 meg, 1 meg, ¼ meg. Linear, Tab., Pots..

2/- ea. 21/- doz.

DUAL CONCENTRIC

1 meg plus 200K plus DPST switch. 1 meg plus 2K standard spindles.

7/6 ea. £4/-/- doz.

AUSTRALIAN B'C BAND STATIONS

Call Sign	Location	(Kc/s) Frequency	Power Watts Authorised
4QL	Longreach, Qld.	540	10000
7SD	Scottsdale, Tas.	540	500
2CR	Orange, N.S.W.	550	10000
7BU	Burnie, Tas.	560	500
2ML	Murwillumbah, N.S.W.	560	200
6WA	Wagin, W.A.	560	50000
3WV	Horsham, Vic.	580	10000
4QR	Brisbane, Qld.	590	10000
7ZL	Hobart, Tas.	600	10000
4AT	Atherton, Qld.	600	500
6NM	Northam, W.A.	600	200
2FC	Sydney, N.S.W.	610	10000
3AR	Melbourne, Vic.	620	10000
4QN	Townsville, Qld.	630	50000
7QN	Queenstown, Tas.	630	200
5CK	Port Pirie, S.A.	640	10000
6AL	Albany, W.A.	650	400
8DR	Darwin, N.T.	650	2000
2NU	Tamworth, N.S.W.	650	10000
2BH	Broken Hill, N.S.W.	660	200
2CO	Albury, N.S.W.	670	10000
8KN	Katherine, N.T.	670	50
8TC	Tennant Creek, N.T.	680	50
2KP	Kempsey, N.S.W.	680	10000
4KQ	Brisbane, Qld.	690	*2000
6WF	Perth, W.A.	690	5000
2NR	Grafton, N.S.W.	700	50000
7NT	Launceston, Tas.	710	10000
7QT	Queenstown, Tas.	720	500
2TR	Taree, N.S.W.	720	200
4QA	Mackay, Qld.	720	2000
6GF	Kalgoorlie, W.A.	720	2000
5CL	Adelaide, S.A.	730	5000
2BL	Sydney, N.S.W.	740	10000
4QS	Toowoomba, Qld.	750	10000
2NB	Broken Hill, N.S.W.	760	1000
3LO	Melbourne, Vic.	770	10000
6VA	Albany, W.A.	780	2000
2KA	Katoomba, N.S.W.	780	*2000
4TO	Townsville, Qld.	780	*2000
4QG	Brisbane, Qld.	790	10000
5RM	Renmark, S.A.	800	2000
6WN	Perth, W.A.	810	10000
2BA	Bega, N.S.W.	810	10000
2GL	Glen Innes, N.S.W.	820	10000
3GI	Sale, Vic.	830	10000
6GN	Geraldton, W.A.	830	2000
4RK	Rockhampton, Qld.	840	10000
2CY	Canberra, A.C.T.	850	10000
4GR	Toowoomba, Qld.	860	2000
7HO	Hobart, Tas.	860	2000
6KG	Kalgoorlie, W.A.	860	2000
2GB	Sydney, N.S.W.	870	5000
3UL	Warragul, Vic.	880	*2000
4WK	Warwick, Qld.	880	*2000
6PR	Perth, W.A.	880	2000
5AN	Adelaide, S.A.	890	2000
2LM	Lismore, N.S.W.	900	*2000
7AD	Devonport, Tas.	900	500
6BY	Bridgetown, W.A.	900	2000
4QB	Maryborough, Qld.	910	2000
2XL	Cooma, N.S.W.	920	*2000
4VL	Charleville, Qld.	920	1000
6NA	Narrogin, W.A.	920	2000
3UZ	Melbourne, Vic.	930	5000
4QY	Cairns, Qld.	940	2000
7ZR	Hobart, Tas.	940	10000
2UE	Sydney, N.S.W.	950	5000
3BO	Bendigo, Vic.	960	1000
4AY	Ayr, Qld.	960	*2000
6TZ	Bunbury, W.A.	960	2000
5DN	Adelaide, S.A.	970	2000
2KM	Kempsey, N.S.W.	980	*2000
6AM	Northam, W.A.	980	2000
2GZ	Orange, N.S.W.	990	2000
3HA	Hamilton, Vic.	1000	2000
6PM	Perth, W.A.	1000	2000
4RO	Rockhampton, Qld.	1000	2000
4CA	Cairns, Qld.	1010	*2000
6GE	Geraldton, W.A.	1010	2000
4IP	Ipswich, Qld.	1010	1000
7EX	Launceston, Tas.	1010	2000
2KY	Sydney, N.S.W.	1020	5000
3DB	Melbourne, Vic.	1030	5000
5PI	Crystal Brook, S.A.	1040	2000
2CA	Canberra, A.C.T.	1050	2000
4SB	Kingaroy, Qld.	1060	2000
2RG	Griffith, N.S.W.	1070	*2000
6WB	Katanning, W.A.	1070	2000
2MO	Gunnedah, N.S.W.	1080	1000
6IX	Perth, W.A.	1080	2000
7HT	Hobart, Tas.	1080	2000
3LK	Lubeck, Vic.	1090	2000
4LG	Longreach, Qld.	1100	2000
6MD	Merredin, W.A.	1100	2000
7LA	Launceston, Tas.	1100	2000
2UW	Sydney, N.S.W.	1110	5000
4BC	Brisbane, Qld.	1120	2000
2AD	Armidale, N.S.W.	1130	*2000
6CI	Collie, W.A.	1130	2000
3CS	Colac, Vic.	1130	1000
2HD	Newcastle, N.S.W.	1140	2000
2WG	Wagga Wagga, N.S.W.	1150	2000
4MB	Maryborough, Qld.	1160	2000
5PA	Penola, S.A.	1160	2000
2CH	Sydney, N.S.W.	1170	5000
3KZ	Melbourne, Vic.	1180	5000
2NZ	Inverell, N.S.W.	1190	2000
5KA	Adelaide, S.A.	1200	2000
2GF	Grafton, N.S.W.	1210	*2000
6KY	Perth, W.A.	1210	2000
3YB	Warrnambool, Vic.	1210	1000
4AK	Oakey, Qld.	1220	2000
2NC	Newcastle, N.S.W.	1230	10000
3TR	Sale, Vic.	1240	2000
8DN	Darwin, N.T.	1240	2000
2DU	Dubbo, N.S.W.	1250	2000
9PA	Port Moresby, N.G.	1250	500
3SR	Shepparton, Vic.	1260	2000
2SM	Sydney, N.S.W.	1270	5000
3AW	Melbourne, Vic.	1280	5000
4BK	Brisbane, Qld.	1290	2000
2TM	Tamworth, N.S.W.	1300	2000
5AD	Adelaide, S.A.	1310	2000
3BA	Ballarat, Vic.	1320	1000
3SH	Swan Hill, Vic.	1330	2000
4BU	Bundaberg, Qld.	1330	2000
2LF	Young, N.S.W.	1340	2000
3GL	Geelong, Vic.	1350	1000
4GY	Gympie, Qld.	1350	*2000
2NX	Bolwarra, N.S.W.	1360	2000
5SE	Mount Gambier, S.A.	1370	500
2LT	Lithgow, N.S.W.	1370	500
2GN	Goulburn, N.S.W.	1380	2000
4MK	Mackay, Qld.	1380	2000
4BH	Brisbane, Qld.	1390	2000
2PK	Parkes, N.S.W.	1400	2000
2KO	Newcastle, N.S.W.	1410	2000
3XY	Melbourne, Vic.	1420	5000
2WL	Wollongong, N.S.W.	1430	2000
2MW	Murwillumbah, N.S.W.	1440	*2000
3CV	Maryborough, Vic.	1440	1000
5AU	Port Augusta, S.A.	1450	500
2MG	Mudgee, N.S.W.	1450	1000
5MU	Murray Bridge, S.A.	1460	500
2NM	Muswellbrook, N.S.W.	1460	500
3MA	Mildura, Vic.	1470	2000
2BE	Bega, N.S.W.	1480	1000
4ZR	Roma, Qld.	1480	*2000
2AY	Albury, N.S.W.	1490	2000
2BS	Bathurst, N.S.W.	1500	2000
3AK	Melbourne, Vic.	1500	500

Continued on facing page

Continued from previous page.

Call Sign	Location	(Kc/s) Frequency	Power Watts Authorised
2NA	Newcastle, N.S.W.	1510	10000
2QN	Deniliquin, N.S.W.	1520	2000
5LN	Port Lincoln, S.A.	1530	200
8AL	Alice Springs, N.T.	1530	50
2VM	Moree, N.S.W.	1530	*2000
2CN	Canberra, A.C.T.	1540	2000
2RE	Taree, N.S.W.	1560	*2000
2LG	Lithgow, N.S.W.	1570	200
3WL	Warrnambool, Vic. ...	1570	200
4GM	Gympie, Qld.	1570	200
5WM	Woomera, S.A.	1580	50
2WN	Wollongong, N.S.W. ..	1580	2000
5MG	Mount Gambier, S.A.	1580	200
4SO	Southport, Qld.	1590	200
5MV	Renmark, S.A.	1590	2000
3NE	Wangaratta, Vic.	1600	*2000

*Operates at night on reduced (usually half) power.

SHORT-WAVE SERVICES

Call Sign	Location	Power (Watts)
VLG	Lyndhurst, Victoria.	10,000
VLH	Lyndhurst, Victoria.	10,000
VLI	Sydney, N.S.W.	2,000
VLM	Brisbane, Queensland.	10,000
VLQ	Brisbane, Queensland.	10,000
VLR	Lyndhurst, Victoria.	10,000
VLT	Port Moresby, Papua.	2,000
VLW	Perth, Western Australia.	2,000
VLX	Perth, Western Australia.	10,000

F. M. Broadcast Services

Location	(Mc/s)	Power (Watts)
Melbourne, Vic.	90.4	2,000
Sydney, N.S.W.	92.1	2,000
Adelaide, S.A.	97.3	3,000
Brisbane, Queensland	94.1	1,000

AUSTRALIAN TELEVISION CHANNELS, STATIONS

Channel 1 49-56Mc.
Channel 2 63-70
Channel 3 85-92Mc.
(or use in inland country areas only)
Channel 4 132-139Mc.
(Available from July 1st, 1963)
Channel 5 139-146Mc.
(Available from July 1st, 1963)
Channel 6 174-181Mc.
Channel 7 181-188Mc.
Channel 8 188-195Mc.
Channel 9 195-202Mc.
Channel 10 209-216Mc.
UHF Channels are provisional only, 50 channels being envisaged between 500 and 855Mc. each 7Mc. wide.

All capital cities will use channels 2, 7, 9 and 10, except Hobart, which will use channels 2, 4, 6 and 8.

Licences have been issued for national and commercial television services to operate in thirteen principle country areas but firm channel allocatons have yet to be announced. More licenses are to be granted in due course.

Stations which are currently operating shortly are listed below.

ABN ..... Channel 2
ATN ..... Channel 7
TCN ..... Channel 9

elbourne
ABV ..... Channel 2
HSV ..... Channel 7
GTV ..... Channel 9

risbane
ABQ ..... Channel 2
BTQ ..... Channel 7
QTQ ..... Channel 9

delaide
ABS ..... Channel 2
ADS ..... Channel 7
NWS ..... Channel 9

erth
ABW ..... Channel 2
TVW ..... Channel 7

obart
ABT ..... Channel 2
TVT ..... Channel 6

OVERSEAS S.W. STATIONS—NOTE

"RADIO, Television and Hobbies" does not publish, nor do we have available, lists of overseas stations, frequencies, broadcast times, etc.

The only information of this type is compiled by our shortwave correspondent, Mr Art Cushen, and published each month on the shortwave page.

For general information on short-wave and other stations, reference can be made to the "World Radio Handbook," available through most large technical booksellers.

ydney

SAVE TIME, MONEY AND WORRY . . .
Send your
METER AND INSTRUMENT REPAIRS
direct to our service department for immediate reliable service.
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FERRIER

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USE AN
IRONCORE TRANSFORMER
TYPE T3/330
6-12-24V 1AMP
FULLY APPROVED
Will Suit All Miniature Irons
IRONCORE TRANSFORMERS PTY. LTD.
HIGSON LANE MELBOURNE C.1
TEL. - 63.4771

AMATEUR BANDS WITH BILL MOORE

SORTING THINGS OUT ON 14 Mc.

The 14 mc/s band is the frequency allocation most widely used for international working among radio amateurs. It is always crowded with signals and changes in operating arrangements for one nation's amateurs can have far-reaching effects on amateurs outside that country.

THE 14 mc/s band is still in the throes of a minor disturbance since the extension of the W telephony allocation to the high edge of the band, 14,350 kc/s, early in the year. Prior to this change the users of the various modes of transmission CW, AM and SSB had effectively sorted themselves into various band segments by mutual agreement. Since the change the band users have tried to settle down to some amended scheme, but there have been plenty of rumblings of discontent and suggestions.

The latter have varied from the climination of CW from the band to a definite sub-division for all types by regulation in some countries. There, too, have been plenty of complaints from users of one mode of transmission that other users of a different mode have been hogging the band.

The ARRL in a QST Editorial believes that the answer for an accepted sub-division can only come from the users of the band on a trial and error basis. No individual or society could hope to promote a scheme acceptable to all.

The League considers there is already a trend for a general agreement where to operate on CW, AM and SSB. About 90 per cent of the users are in accord with a scheme on the following lines: 14,000, 14,100 reasonably free for CW, 14,100-14,200 foreign AM Fones, a rough half split in the US telephony segment with AM in the lower 75 kc/s and SSB in the higher 75 kc/s, with some space left near 14,350 for rare overseas SSB stations to break through.

The ARRL expresses appreciation that, despite quite a deal of opposition to the extension, overseas amateurs have been very understanding in view of the QRM problem in the US with two-thirds of the world's amateurs licensed in that country. The friendly co-operation that exists between the members of the service throughout the world, will ensure a "gentleman's agreement" for 14 mc/s band usage in the future.

Field Day

THE annual Field Day of the Blue Mountains Section of the W.I.A. was held on October 30. Well over 100 persons attended the event, held at the Lawson Swimming Pool. Despite an empty pool, and bus transport problems, the day was voted a success. A number of visitors came from considerable distances, including Major and Mrs Collett, VK2RU, from Gosford, and Nev. and Mrs Wilde, VK2DR, and Graham and Mrs Nixon-Smith, VK2AGN, from Bathurst.

Dave Andrews, VK2AWZ, made a clean sweep in the field events, winning all three, the 144 mc/s Hidden Transmitter, the 144 mc/s Scramble and the 7 mc/s Scramble—a fine record. Dave has plenty of cups on the mantelpiece for his efforts in these events. Bob Lear, VK2ASZ, was the fox on the occasion, while Wal Cromie, VK2MZ, supplied the transmitter for the Blindfold Hunt.

Winners of the prizes for the various events were as follows: Blindfold Hunt, Allen Walker, VK2ZFW, gents.; 1st, Mrs VK2AGN, 2nd Mrs VK2ADF ladies. Gent.'s Numbers, 1st Keith King, VK2ABK; 2nd, Nev Wilde, VK2DR; 3rd, Bob Lear, VK2ASZ. Ladies' Numbers, 1st, Mrs VK2EX; 2nd, Mrs VK2ZVL; 3rd, Mrs VK2WJ.

144 mc/s Hidden Transmitter, 1st, Dave Andrews, VK2AWZ; 2nd, John Lark, VK2ZAV.

7 mc/s Scramble, 1st, Dave Andrews, VK2AWZ, 16 contacts; 2nd, Geoff Warner, VK2CK, 11 contacts, and 3rd, Graham Nixon-Smith, VK2AGN, 9 contacts.

144 mc/s Scramble, 1st, Dave Andrews, VK2AWZ, 18 contacts; 2nd, Dick Norman, VK2ZCF, 16 contacts.

Both scrambles were run over 30-minute periods, and better than a contact every two minutes was required to win.

Local amateurs who worked towards the success of the day included chairman of the section, VK2ABK, VK2QA, VK2AVK, VK2NK, VK2RM, VK2ADF, VK2MZ, VK2ASZ and associate Les Stahl.

Annual Convention

ARRANGEMENTS for the N.S.W. Division's annual convention, to be held over the Australia Day weekend at the end of January, are well in hand. Much of the preparatory work on the VK2WI Dural grounds is complete, and organisers are concentrating on the features for the 1961 convention. The 1960 event attracted the largest crowd yet to assemble at such a day, 400 persons attending. Special attractions are being arranged, and amateurs would be well advised to keep the weekend clear for the trip to Dural.

N.S.W. Division, W.I.A.

BOB WINCH, VK2OA, was the fox at the October Nocturnal Hunt of the N.S.W. VHF and TV section. Keith Laws, VK2ZVL, ran out a clear winner, locating the hidden transmitter in just on one hour. Second to arrive was Dave Andrews, VK2AWZ, and third Allan Hennessy, VK2RX. Nine cars finally finished at the spot.

John Deering, VK2ND, lectured at the October meeting of the Central Coast section of the N.S.W. Division of the

R.S.G.B. NATIONAL CONVENTION

A FEATURE of the RSGB's 1960 National Convention was the wide coverage of important technical subjects by a series of lectures presented by noted authorities in their fields. The convention was held at Cambridge and ran for three days in the University Examination Halls. This building also housed the reception desk, the convention station (operating on all bands 1.7 mc/s through 144 mc/s), a display of electronic equipment and provided a lounge for the inevitable rag-chew.

Besides the lectures, technical visits to centres of telecommunication import were conducted for the OM's.

Special trips to places of interest were arranged for the ladies. An indication of the wide field covered by the lectures can be obtained from the following list of discourses as presented: "Fundamental Research and Practical Telecommunication," by J. A. Radcliffe, F.R.S.; "Micro Wave Radio Link Equipment," by T. P. Blott; "Telecommunications In The Body," by P. E. K. Donaldson, M.A.; "Recent Development In Micro Wave Valves," by A. H. Beck, M.A., B.Sc.; "Recent Developments In Semi-Conductors," by T. D. Towers, M.B.E., M.A., B.Sc. (ex-VP2GM); "The Mullard Radio Observatory," by Professor M. Ryle, F.R.S. (G3CY); "Single Sideband," by G. C. Bagley (G3FHL); "The Electronic Telephone Exchange," by D. Delanoy (G3FOQ); "Industrial Television," by I. Waters (G3KKD/T); "Low Noise Receivers Using Maser and Parametric Amplifiers," by F. G. Smith, M.A., Ph.D. and "Whistling Atmospherics," by B. H. Briggs, M.A., Ph.D (G2FJD).

There were other features including group discussion and demonstrations covering more mundane subjects for radio amateurs such as DX, VHF's, RTTY, Mobile Operations and Amateur Television.

Visits arranged included inspections of the University Engineering Laboratory, the University Mathematical Laboratory, the TV Micro Wave Link at Barkway (a 7,000 mc/s link), Little Barford Generating station, the Pye Telecommunications factory and the Mullard Radio Observatory.

The above features were programmed over two days, allowing those attending a selection of lectures or visits. The convention committee decided that the theme of the gathering should be "The influence that fundamental research has had on practical communications."

The venue Cambridge and the University with its great wealth of research, both past and present, provided an ideal setting for such a gathering. Most of the lecturers hold or have held amateur call-signs and the material was presented in such a manner that it could be understood by radio-amateurs.

A. He covered a popular subject, conversion of command transmitters. The N.S.W. Divisional Council has cided to suspend its nightly Morse ictices on 3525 kcs during DX con- ts on CW. They are conducted at critical time for DX contest operators 30 hours EAST. With the sun-spot xima well past, the 3.5 mc/s band comes more important for contest thusiasts, and much of the Pacific d American DX appears around that ur.

Army Radio Club

HE Army Radio Club (Northern N.S.W.) was recently granted the call n VK2AVX. It is the station of the M.F. Signals Corps in the Newcastle ea. Club membership is limited to ving members of the Citizen Military rces and Regular Army staff. The n of the club is to promote amateur dio and as a training ground for citizen ldiers interested in communications to alify at the A.O.C.P. examination.

Spring Festival

T the Gold Coast Spring Festival held in October the Southport Amateur adio Club provided a large display of nateur radio equipment in the Guide all, Southport. The club station, K4SR, was on the air with 100 watts a Hallicrafter HT9 transmitter and C348 receiver. Members operated the ation, contacting 11 countries, including od prefixes in Nepal and Guatemala. ecial cards will be sent to all stations orked, together with brochures on the old Coast Spring Festival. The exhibit eated much interest, gained the club w members, and many lads and fathers e now interested in the hobby. The ubrooms are situated at 8 Bellevue arade, Heydon Heights, Southport, and terested persons can ring the president 2-2818 or write the secretary, Ray umble, at the address given.

50 Mc. DX Report

YDNEY VHF stations were among the 50 Mc/s DX in October. Early in ie month contacts were established with lawaii and Japan. It is some 10 years nce communication with KH6 was last stablished from this area. Dick Nor- an, VK2ZCF, was first to break rough with three QSOs with KH6; later eith Laws, VK2ZVL, also made ontacts. The opening occurred at mid- ight Z and signals were at good strength or some 30 minutes. At the time TV gnals at 48 Mc/s were audible and a umber of other stations in this region ere coming through. Later the JAs ppeared and Dick contacted 15 of them p to 0630Z. Later in the month various penings to Japan occurred and various ontacts were established.

Mobile Rallies

MOBILE rallies are still the most popu- lar form of field entertainment for adio amateurs in the U.K. and more an 1,000 persons have attended such vents. Eight hundred amateurs and nthusiasts recently attended such an vent held at Harewood House by per- ission of H.R.H. the Princess Royal. novel event conducted on this occasion or mobile operators consisted firstly of ie arranging of all competitors' QSL ards face down on the ground. The ntrants then had to find their own card, nake a dash for their car, switch on the quipment, transmit his callsign and a code number. The first stations identified by the rally station were the winners. A second event attracting 600 was held at R.A.F. station Barfort St. John, where the U.S.A.F. were the hosts. An extensive program of events was arranged and KL7KLS was the organiser. Some 30 K/W amateurs stationed in the U.K. attended. More than 500 contacts were made by stations at the rally.

Prefixes varied

STATIONS in the U.K. are now permitted to vary their prefixes when operating at alternate addresses. The following arrangement resulted after discussions between the R.S.G.B. and the British Post Office. G3XYZ would use the call GW3XYZ when operating in Wales or GD3XYZ when on the Isle of Man. In reverse GI3ZXY would use the call G3ZXY when in England. The suffix /A must be added when operating from a temporary address or location.

Family Hamfests

FAMILY Hamfests are a feature of amateur activity in Florida, U.S.A. They are called "Hamborees" and provide entertainment for all members of the family. Family nets are also sponsored. A typical one is the "Flamingo Net" operating on 28 and 144 mc/s, and all members of the family join in the discussions. Evelyn, W4WYL, described the efforts on above lines aimed at family harmony in a recent Voice of America amateur broadcast. Amateur radio is no longer a hobby for the O.M. only; all can make friends and enjoy the pleasures of amateur radio.

Greater attention is being given to the entertainment of the XYLs and YLs at ARRL State and division conventions that are organised in various centres annually. Special dinner dances with well-known orchestras are often featured, plus mixed banquets, tours, etc. An interesting variation is the conducting of FCC amateur licence examinations during conventions, but in all cases the trend is for better entertainment and facilities for the fair sex.

DX Contest

RECORDED scores in the 1960 ARRL DX contest in the CW section were the highest of all time. W0NWX who journeyed down to British Honduras and operated as VP1JH made over 4,000 contacts, one every 1½ minutes for the 96 hours of the contest. His score for the CW section was 1,378,000 points. A number of scores were over the one-million mark. Leading stations in these regions were ZL1MQ and VK2GW. The phone section scores were not as high as usual, due mainly to the SSB/AM split of activity in this section. Highest scores came from Latin and South American stations who can work into the States on most bands for long periods. Incidentally, 25 years ago, the leading scorer was W3SI who tallied 48,000 points, which was hailed as quite an achievement at that time.

Transatlantic 144 Mc.

A SPECIAL plan is being sponsored by the Irish Radio Transmitting Society to bridge the Atlantic on 144 Mc/s from the west coast of Ireland in 1962. EI2W well-known VHF enthusiast is in charge of the project. Special facilities are being arranged for the clearance of imported equipment for installation at the station.

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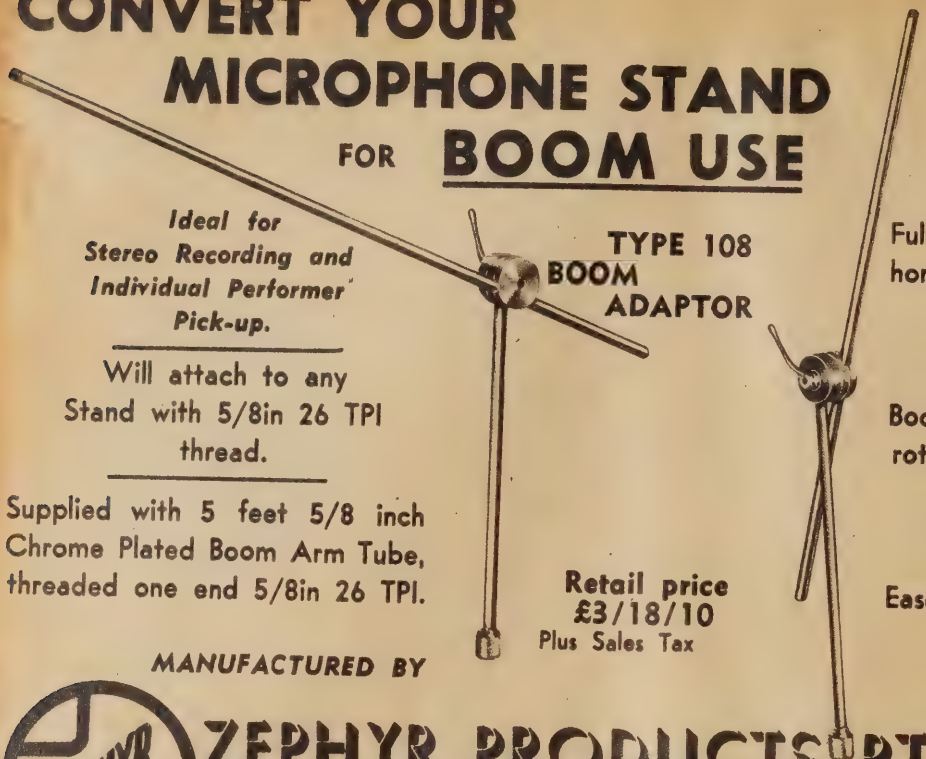

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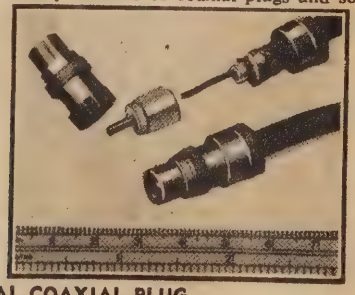

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(Nickel-plated for equipment makers extra)

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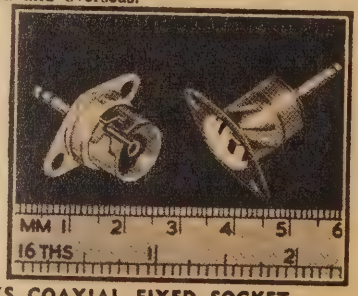

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"Personal" Magazines

ANOTHER feature of amateur radio activity gaining popularity in the U.S. is the publication of State-wide magazines covering more personal details of amateur activity. They provide much more information of a type that national journals such as QST and CQ can cover. "Florida Skip," printed in that State, runs to 3,000 copies a month. Over 30 correspondents provide news of all types of amateur activity within Florida. All work by amateurs is on voluntary basis.

Advertising revenue covers publication and printing costs.

Similar journals appear in other sections of the U.S. and are gaining support. Every amateur can talk at length via their stations with amateurs in other parts but not every operator is vocal. Some like to experiment, others to read of the doings of their fellow amateurs, hence the popularity of these magazines devoted to personal activities.

Colour TV

FIRST experimenter producing colour TV is Melvin, W0KYQ, whose amateur system transmits slides and drawings with excellent clarity. The signal on 420 mc/s. compares favourably with those of commercial installations.

The transmission is viewed on a standard colour TV receiver, with a 420 mc/s. converter. By using junk box parts and two give-away TV receivers, the cost of the whole system was kept down to 175 dollars.

Reporting System

IT is just 25 years since the general adoption by amateurs of the present RST system of reporting. Previously the Tone reporting was limited to PDC, QC, RAC and the like. An RST scheme was proposed some time before with a strength scale from 1 to 5 but it was never popular. A nine figure scale was then suggested and the RST system immediately took on. W2BSR was responsible for fostering both schemes. QB's over S9 did not arrive until some years afterwards. S meters were not common in those days.

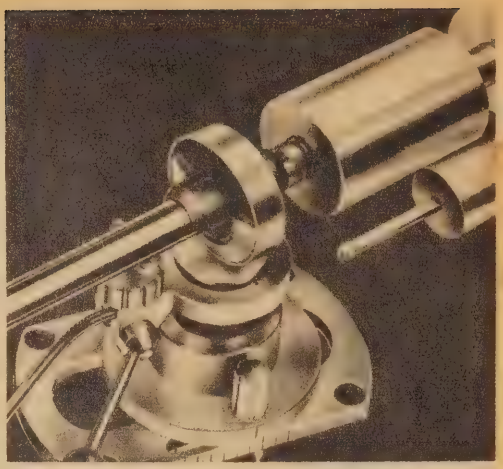
Telephony Contest

DECEMBER 3 and 4 is the weekend of the R.S.G.B.'s Telephony Contest on the 21 and 28 Mc/s bands. Amateurs throughout the world are invited to work G, GM, GW, etc. stations in the U.K. Only one contact may be made with any station for the purpose of a score on each of the bands. The usual serial number must be exchanged, RS and three figures denoting the number of the contact commencing with 001. Logs should be sent to the R.S.G.B. Contest Committee, New Ruskin House, Little Russell St., London, W.C.1, England.

DX Honour Roll

THE telephony gang are fast catching up with the CW group in total countries on the ARRL's DX Century Club's honour roll. CW men ZL2GX and W1FH still rate 300 countries confirmed each. On phone PY2CK now has a total of 297 confirmed with VQ4ERR and ZS6BW close by on 292. It is strange not to see a W station ranking in the first three.

Illustrated at right is the unique system which provides complete lateral and longitudinal balance, eliminating side pressure. Arm is carried on virtually frictionless knife edges.



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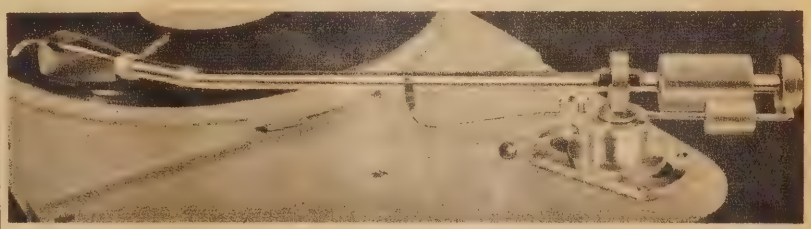

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ON SHORTWAVE — By ART CUSHEN

N ENGLISH FROM NEW CALEDONIA

Our nearest neighbour New Caledonia is to have English broadcasts, and these are scheduled to commence next month.

ADIO Noumea in New Caledonia has long provided listeners on both es of the Tasman with good signals, d though the broadcasts have in the st been in French, they have a listen- audience in the South Pacific in ner French territories.

The announcement by the station that m January 1, 1961, English programs to be broadcast will result in a eater interest in the transmissions on dio Noumea, which is using 6035 Kc. esent broadcasts are best from 5.00 8.30 p.m., in the service for listeners, d this is carried in French. The an- uncement from the station indicates session will be heard in Australia, w Zealand, Fiji, Solomons and other eas of the South Pacific.

The recent ending of the English oadcasts from Radio Tahiti at Papeete s meant that no broadcasts in English om a French station have been received gularly in this area, so that the deci- n of Radio Noumea will be received th more than the usual interest.

Vienna Uses 50 KW

HE report last issue of our reception of the broadcasts from Austria has abled many listeners to hear this test nsmission, and further information on programs are now to hand. The nsmissions are carried on a new 50 v. transmitter, and the amended sche- le is as follows: 9.00 to 11.00 p.m. 9770 Kc., from 12.00 to 3.00 p.m. d from 11.00 p.m. to 5.00 a.m. on 45 Kc., from 7.00 to 9.00 p.m. on 00 Kc., and from 3.00 to 7.00 p.m. d 5.00 to 7.00 a.m. on 6155 Kc. Re- rts should be sent to the Austrian dio, Short Wave Service, P.O. Box 0, Vienna, Austria.

4VEH On 6120 Kc.

ROADCASTS from Radio 4VEH in Haiti with transmissions from Cap itian have been observed on the new quency of 6120 Kc. The station made move from 6000 Kc. to avoid the in- ference from Radio Swan. The two w transmitters of 2,500 watts are now ing tested on 6040 Kc. and on 1050 . medium wave. The station on short ve will possibly use 6120 or 6000 Kc. ien in regular operation. The Inter- tional Telecommunications Union has signed the Haitian stations the follow- frequencies: 6000, 9770, 11835, 260, 17730 and 21520 Kc.

ddis Ababa On 11875 Kc.

EASONABLE signals are being re- ceived from the "Voice of Ethiopia" Addis Ababa, which is carrying out t transmissions on two frequencies, 875 and 15345 Kc.

The signals on 11875 Kc. are fairly od and free from interference, but se on 15345 Kc. suffer from severe nming. It is found that the test com- mences at 4.15 a.m. to sign off at 4.40 a.m. The station played light orchestral music with the taped announcement heard after each recording.

The station announcement was, "This is Radio Addis Ababa. We are carrying a test broadcast for Western Europe on 11875 Kc., and one directed to West Africa on 15345 Kc. We would welcome reports as to signal strength from listeners, and these should be sent to Radio Addis Ababa, Ministry of Information, P.O. Box 1364, Addis Ababa, Ethiopia."

Notes from readers should be sent to Arthur Cushen, 212 Earn Street, Invercargill, N.Z. All times are Eastern Australian Time.

Schedule From Montreal

BROADCAST from Radio Canada has shown an extension to the programs for listeners in northern Canada, and this new schedule includes this information and some frequencies which have been altered in other transmissions.

AUSTRALASIAN SERVICE
6.25 to 7.05 p.m. 9630 Kc.
EUROPEAN SERVICE
9.25 to 12.30 a.m. 21600 Kc.
9.30 p.m. to 5.30 a.m. 17820 Kc.
12.45 to 7.30 a.m. 15320 Kc.
6.00 a.m. to 7.30 a.m. 11720 Kc.
NORTHERN SERVICE
8.00 to 8.45 a.m. 11720, 9585 Kc.
LATIN AMERICAN SERVICE
9.00 to 9.30 a.m. 15190, 11760 Kc.
9.30 to 10.45 a.m. 15190, 11760 K.c
NORTHERN CANADA SERVICE
11.00 a.m. to 5.05 p.m. 11720, 9585 Kc.

Kabul On 15385 Kc.

RADIO KABUL in Afghanistan changed from 9705 to 15385 Kc. some weeks ago, but it is only now that fair reception has been possible. Kabul is heard on 15385 Kc. in English from 5.00 to 5.30 a.m.

The station suffers from side interference from B.B.C. London on 15375 and Radio Moscow on 15390 Kc., and from 5.25 a.m. jamming is prevalent on the transmission. News in English is broadcast at 5.05 a.m. and at 5.15 a.m. a program of music local in nature follows to close down at 5.30 a.m., which is equivalent to midnight in Kabul.

Iran On 15100 Kc.

RECEPTION from Radio Teheran, which in the past has been difficult, when using 15120 or 9680 Kc., has improved with the use of the new 15100 Kc. frequency. The station opens at 5.30 a.m. in Persian, and at 6.00 a.m. carries programs for 15 minutes in Russian, Turkish, French and English. The station requests reception reports to Radio Teheran, Iran.

The program in English consists of news and then some Persian music to sign off. It has been noted that on Saturdays the station only broadcasts to 6.30 a.m.

FLASHES FROM EVERYWHERE

LISBON has replaced its out of band frequency, 6373 Kc., by a new channel, which has resulted in poorer reception. Radio Lisbon is now using 6025 Kc. from 4.00 to 10.00 a.m.

ISTANBUL'S Technical University has a broadcast of music each day from 4.15 to 6.15 a.m. European listeners report good reception of this Turkish station, which operates on 6285 Kc.

SOUTH AFRICA has made a frequency change for its 19 metre band outlet; it is now heard on 15265 Kc. at 3.00 a.m. Signals suffer from interference from Moscow at 3.30 a.m., but the same program can still be tuned on 4810 Kc.

INDONESIA has dropped in frequency from 9593 to 9585 Kc. for its session in English for listeners in Australia and New Zealand broadcast from Djakarta at 9.00 p.m. daily. The Voice of Indonesia also is heard on 11795 Kc. and in addition to the session at 9.00 p.m. another service is from 12.30 to 1.30 a.m. To Europe from 2.15 a.m.

BROADCASTS FROM STOCKHOLM

RADIO SWEDEN has introduced a new schedule and this finds the use of the lower frequencies more pronounced. As sunspot activities decrease, all short wave transmissions now show the tendency for lower frequencies.

10.30 to 11.45 p.m.	Far East on 7210, 9620.
Midnight to 12.30 a.m.	North America, 17840 Kc.
12.45 to 2.00 a.m.	South Asia, 9620, 11880 Kc.
2.15 to 3.30 a.m.	Northern Europe, 11705, 15240 Kc.
3.45 to 5.00 a.m., 5.15 to 6.15 a.m.	North Europe, 11705, 15240 Kc.
9.00 to 11.30 a.m.	South America on 9620, 11705 Kc.
11.00 a.m. to 1.15 p.m.	South America, 11705 Kc.
2.00 to 2.45 p.m	Central America, 9620 Kc.
11.00 a.m. to 12.15 p.m.	North America, 9620 Kc.
12.30 p.m. [illegible]45 p.m.	North America, West Coast, 9620 Kc.

ACOS REPLACEMENT CRYSTAL CARTRIDGES

GP67—1G
A high quality monaural turnover cartridge with an extended frequency response and excellent tracking capabilities. A standard replacement crystal cartridge for most players and changers. Replaces HGP37 and GP65 series. Standard ½" mounting bracket.
Improved performance.
PRICE
Twin sapphire Styli £2/18/6.
Sapphire-diamond Styli £4/19/6.

GP67-2G.
High gain turnover crystal Cartridge, suitable for reproducing standard and micro-groove recordings with low gain amplifier.
PRICE: Twin Sapphire Styli, £2/3/-. Sapphire/diamond Styli, £4/4/-.

GP61
Turnover ceramic Cartridge. Unaffected by heat or humidity. Specially designed for tropical areas.
PRICE:
Twin Sapphire Styli, £2/18/6. Sapphire/diamond Styli, £4/19/6.

HGP39
Crystal Cartridge. Available for standard or L.P. recordings for use with HGP20 and HGP40 Pick-up Arms.
PRICE:
Single Sapphire Stylus, £3/12/6. Single Diamond Stylus, £5/13/6.

ACOS STEREOPHONIC CARTRIDGES

GP73 Series
Turnover stereophonic Cartridge, plays all types of recordings. GP73-2 Medium output. GP73-5 High output. Available with standard ½" mounting bracket (type A), or special mounting bracket for end mounting (type B).
PRICE: Twin Sapphire styli, £3/6/-. Sapphire/diamond stylus, £7/13/6.

GP71 Series
Cartridge plays stereo and L.P. recordings, non-turnover type.
PRICES: GP71 with sapphire stylus, £3/6/-.
GP71 with diamond Styli, £5/16/6.

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WHENCE came the knowledge that built the Pyramids and the might Temples of the Pharaohs? Civilization began in the Nile Valley centuri ago. Where did its first builders acquire their astounding wisdom that starte man on his upward climb? Beginning with naught they overcame nature's forces ar gave the world its first sciences and arts. Did their knowledge come from a race no submerged beneath the sea, or were they touched with Infinite inspiration? Fro what concealed source came the wisdom that produced such characters as Amenhote IV, Leonardo da Vinci, Isaac Newton and a host of others?

Today it is known that they discovered and learned to interpret certain *Secret Metho* for the development of their inner power of mind. They learned to command tl inner forces within their own beings and to master life. This secret art of living h been preserved and handed down throughout the ages. Today it is extended to tho who dare to use its profound principles to meet and solve the problems of life these complex times.

This Sealed Book—FREE

Has life brought you that personal satisfaction, the sense of achievement and happ ness that you desire? If not, it is your duty to yourself to learn about this ration method of applying natural laws for the mastery of life. To the thoughtful persc it is obvious that everyone cannot be entrusted with an intimate knowledge of th mysteries of life, for everyone is not capable of properly using it. But if you are or of those possessed of a true desire to forge ahead and wish to make use of the subt influences of life, the Rosicrucians (not a religious organization) will send you Sealed Book of explanation without obligation. This Sealed Book tells how you, the privacy of your own home, without interference with your personal affairs manner of living, may receive these secret teachings. Not weird or strange practice but a rational application of the basic laws of life. For your complimentary cop address your request to: Scribe A. Y. P.

The ROSICRUCIANS
(AMORC)
3988, G.P.O., SYDNEY, AUSTRALIA

is on 11825 and 9585 Kc., English ng heard in this session from 5.00 to 0 a.m.

ORDAN with its high power trans- ter has been heard in the North erican area on 9530 Kc. opening at 0 p.m. This program includes not y Arabic, but Western music and it presumed that signals would be lible at other times on this new fre- ncy.

SOUTH AFRICA BROADCASTING RPORATION has altered its 41 tre band frequencies. The Springbok mmercial programs, which were on 5 Kc., have moved to 7185 Kc. to 0 a.m. and the Afrikaans program on 5 Kc. has moved to 7295 Kc.

GOA in Portuguese India has been ed on 17835 Kc. from 3.25 to 5.30 ., with good strength, which indi- ed that the new 50 Kw. transmitter y be in operation. Radio Goa is eduled to carry its program from 4.30 5.30 a.m., and the news in English listed for 5.00 a.m.

RADIO CARIBE in Ciudad Trujillo altered its frequency to 6120 Kc. m the former 6090 Kc. It is now ar of any interference and can be rd opening at 8.00 p.m. Signals are d on 6120, H12U and also on 9485 . H13U, when the station commences day's operation at 8.00 p.m.; preced- this a piano identification is given about 10 minutes.

LUSAKA in North Rhodesia has been ted to sign off at 5.00 a.m. 3954 Kc. k Pollard, of Nelson, N.Z., reports d signals on this transmission of the deral Broadcasting Service in North- Rhodesia.

RADIO SENEGAL in Dakar is the gan of the station, since the break- ay from the Mali Federation of Sene- . This slogan is used in the station's adcasts from 6.00 a.m. on 15385 Kc.; this time the transmission is in French d broadcasts in English normally take air at 6.20 a.m., though in this area reception suffers considerably from jammers on adjacent frequencies.

DELHI has a transmission to East rica and Mauritius, and the session is the air from 12.45 to 1.30 a.m. in al languages, when it reverts to Eng- h for the period 1.30 to 1.45 a.m. The tion uses 7225 Kc. and 9605 Kc.

RADIO NACIONAL in Lima with Kw. transmitters has a service to rope on 15150 Kc., with English at 0 a.m., on Tuesday, Thursday and turday; French, German and Spanish low each quarter-hour to 8.00 a.m. the Orient on Friday on 15150 Kc., in Japanese at 8.00 a.m. and English 5 a.m., to North America, on Thurs- y, with English at noon, Spanish at 15 p.m.

ANGOLA station CR6RY at Nuevo ndo on 4838 Kc. has been noted to 25 a.m. CR6RN at Luanda on 4869 . has been also noted to 8.30 a.m. South Africa.

CENTRAL AFRICAN REPUBLIC 5982 Kc. with broadcasts from ngue is now noted at 5.00 to 6.00 n. with programs in French, with the vn used also as the slogan for identi- ation.

GHANA on 7285 Kc. has been heard m 6.00 to 6.45 a.m. with a test, and gram was in English except from 5 to 6.30 a.m., when the session was French. Installation of four 100 Kw. nsmitters for the Ghana Broadcasting Service at Accra has been going on and this could be one of the initial tests before regular transmissions are commenced.

ANKARA, Turkey, with the service to Europe has vacated its 15160 Kc. channel in favour of the 7285 and 9745 Kc. channels. The session in English is now heard at 4.15 and 7.00 a.m., and German at 5.15 a.m., French at 6.15 a.m.

SOUTH AFRICA with its African service is now on the air from 9.00 p.m. to 6.00 a.m. with reception on 25800 Kc. from 9.00 p.m.; on 21570 Kc. from midnight; and then from 4.00 a.m. on 15270 Kc., but the last two mentioned frequencies, when heard in Europe, were noted to have interference on the transmissions from Moscow.

ATHENS in Greece with its English program at 3.45 a.m. has been noted on 15345 Kc. with 11720 Kc. for reception in Western Europe. French is at 3.30 a.m. and English at 3.45 a.m.

BRAZIL'S official voice, Radio Nacional in Rio de Janiero, is now using three frequencies, when opening its transmissions at 6.15 p.m. The programs can now be tuned on 6147, 9720 and 15285 Kc., from the sign on at 6.15 p.m.

HAITI has a new station, Radio Caraibes, which is using 6005 Kc. with the call sign 4VED. The station verifies reports with a letter and the address is "Radio Caraibes" 23, ruelle Chavannes, Port au Prince.

JAPAN'S Home Service relay of the NHK programs has been noted on the new frequency of 7230 Kc. The station was formerly on 7257, the other outlets 9665 and 7285 are still in service. The "Voice of the United Nations Command" is heard with the VUNC programs on 6015, 7270, 9560 Kc. from 9.00 p.m. to 7.00 a.m. with programs in Korean, Mandarin and Chinese. The station announcement is, "This is VUNC in Tokyo calling Korea." The other outlet, which has been assigned to VUNC 11890 Kc., has not been heard recently.

BRAZZAVILLE is being heard at midnight in the 13 and 16 metre bands. The session is in English and is tuned on 21500 and 17720 Kc. Another frequency for Brazzaville is heard on 9605 Kc. to sign off at 8.00 a.m.

SENEGAL, the former Mali Federation, is broadcasting to Europe on Wednesday and Saturday from 3.35 to 4.00 a.m. on 15290 Kc. Listeners in Europe report reception of the broadcasts in French, English and German and these consist of news on the political position in the former French colony.

ICELAND has moved from its out of band frequency of 12185 Kc. to the new 11780 Kc., and is reported from North America as opening at 6.00 a.m. on this outlet. The station has gongs and identifies in Icelandic before the transmission commences. Signals are only poor in this area, and interference is severe from the B.B.C. European transmissions now using 11770 Kc.

CAIRO with its transmissions for the United Arab Republic has dropped further in frequency for its service to Europe. The broadcast from 5.00 a.m. to 8.30 a.m. is now on 11915 Kc., and the program in English is broadcast from 7.30 a.m. A new transmission, which is directed to West Africa, is broadcast on 17690 Kc., and this concludes at 7.45 a.m. with a program in English.

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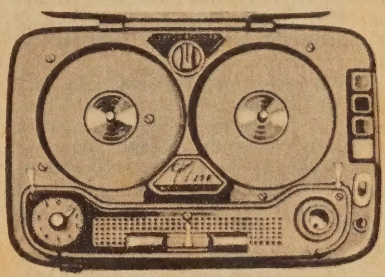

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* Fast forward and rewind facilities.
* Headphone monitoring facilities.
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* Microphone for hand or stand mounting.
* Power output 2.5 watts.
* Built in modulation level indicator.
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ANSWERS TO CORRESPONDENTS

R.J.Y. (Clayton, Vic.) asks us if we intend publishing details of a tape adapter to suit the "Playmaster" series of amplifiers. He feels that many readers must have existing amplifiers of this type, and would be very interested in using them for high-quality tape recording.

A.: We have considered designing such a unit, R.J.Y., but as yet we are a little unsure of its reception among readers, particularly since the recent boom of stereo began. If we receive sufficient indication of the need for such a unit, we will certainly reconsider seriously this project.

S.D.W. (Nambour, Q.) writes to comment on the problem of obtaining very low consumption bulbs for instrument illumination where battery drain must be considered. He also passes on a few tips for possible use in the magazine.

A.: We agree that your problem is a difficult one, S.D.W., particularly as your need may be an isolated one at present. For this reason lamp manufacturers would not be interested in making the small quantities involved. However, we suggest you write direct to such firms as Philips, Siemens, etc., and state your problem. It is quite likely that a suitable bulb exists in, say, the medical range, which is not likely to be available over the counter. Many thanks for the handy hints which will be filed for possible future use.

R.O. (Maitland, N.S.W.), asks us for information regarding Radio Control regulations, frequency allocations and licences.

A.: We are afraid we cannot help you directly, R.O., but suggest you contact the P.M.G. Wireless Branch, c/- G.P.O., Sydney.

P.S. (Nth. Essendon, Vic.) sends us details of a reaction timer, with the hope that we may be able to include it in the "Reader Built It" section of the magazine.

A.: Thank you very much for the interesting circuit and explanation, P.S., which we read with considerable interest. We think it should appeal to a number of our readers, and will endeavour to include it in the magazine at an early date.

A.F.G. (Charters Towers, Nth. Qld.) sends us a query about reed organs, in particular the factors governing the tone of a reed. He hopes it can be answered in the "Here's Your Answer, Tom" section of the magazine.

A.: Thanks for your most descriptive letter, A.G.F. As you have no doubt noticed, we are at present running a series of articles on the theory of measuring instruments in the "Answer Tom" section of the magazine. However, we will endeavour to answer this and similar queries in the magazine, either after this series of "Answer Toms," or in a specific article.

(Note: If other readers would be interested in seeing articles on pipe and reed organs, we would appreciate a few words from them.)

W.J.J. (Nedlands, W.A.) asks if we have considered publishing a circuit for a transistorised short-wave set or converter, as he feels that there would be a large number of readers interested in such a unit.

A.: We have had this idea in mind for some time, W.J.J., and as a matter of fact we are at present engaged in the development of an eight transistor short-wave receiver. However, there are a number of points about the design which are not fully to our satisfaction as yet, so we ask your patience in the matter.

J.F. (Watsons Bay, N.S.W.) comments on our recent article on "Miller Effect."

A.: Thanks for your comments. No offence was meant by omission of the "Mr." In fact, it would seem inappropriate in the particular style of the sentence. It is true that Miller Effect reduces gain but only at the frequencies at which it is apparent. This is, in fact, Miller effect. The point you are apparently trying to make is somewhat obscure.

A.P.C. (no address) suggests that we use drawings for the underneath view of our projects, as many photographs reproduce quite badly in the magazine.

A.: We are aware of this problem, A.P.C., but cannot do much about it, due to staff and time shortages. You will appreciate, of course, the time required to draw a detailed view of the underchassis of each of our projects.

However, we have available original, glossy views of most of our projects (see the information panel on this page), which convey considerably more information than that published in the magazine.

Regarding the Transistor Telephone, about which you also inquire, we regret that we cannot help you in this matter.

R.W.D. (Kedron, Brisbane) sends us suggestion for a One-Transistor Pocket Radio, similar to that published in the July, 1960, issue of "Popular Electronics."

Many thanks for the suggestion, R.W.D., which we will bear in mind regarding future projects.

D.A (Wellington, N.Z.) sends us a circuit and details for a Morse Code Oscillator which he has built successfully, suggesting that we may care to use it in the "Reader Built It" section of the magazine at a later date.

A.: Thanks for the circuit and data, D.A., which we will certainly bear in mind with a view to its future inclusion in the above section of the magazine.

A.E.F. (Dalby, Qld.) asks if we have ever described a transistorised tape recorder amplifier in the magazine.

A.: Sorry, A.E.F., but to date we have not described such a circuit. We have had the matter under consideration for some time now, but as yet have no definite plans. It is therefore rather unlikely that we will be publishing details of such a unit in the near future.

RADIO, TELEVISION AND HOBBIES QUERY SERVICE

TO assist our readers, "Radio, Television and Hobbies" conducts a technical query service. Conditions governing this service are set out below:—

(1) Requests for copies of circuits or technical queries requiring an answer through the post must be accompanied by postal note or stamps to the value of TWO SHILLINGS. Queries not accompanied by a fee will be answered in rotation on these pages.

(2) For the 2/ fee, we will supply circuit data, as available, for up to three projects. The amount of data available varies, but in no case can it include information additional to that already published in the magazine. As a rule, requests for circuits will be answered more speedily if they are clearly identified and not complicated by questions requiring the attention of technical personnel.

(3) The technical query service is aimed primarily at assisting readers in matters relating directly to articles published in the magazine. Answers will be given in note form and only so far as can be drawn from general knowledge of the relevant subject. We cannot provide lengthy answers, undertake special research, discuss commercial designs or draw special circuits.

(4) The Editor reserves the right to return query fees or to limit the scope of an individual reply, where it is felt that a partial answer will be better than none at all. Please note that the inclusion of an extra fee does NOT entitle correspondents to special consideration.

(5) In addition to the normal query service, chassis blueprints are available for most of our projects, showing the position of all holes and cutouts for metal-working but containing no details of wiring, etc. Apart from complicated projects like TV sets and oscilloscopes, most blueprints cost 5/ each. Original photographs of most projects are also available, from 5/ for a 6in x 8in glossy print; postage 9d extra.

(6) Letters should be addressed to the Technical Editor, "Radio, Television and Hobbies," Box 2728, G.P.O., Sydney.

(7) "Radio, Television and Hobbies" does not deal in radio components nor will we debate the relative merits of competitive products. Prices and specifications of merchandise must be obtained from our advertisers.

(8) Technical queries are not answered by telephone.

AMATEUR THREE-BAND CONVERTER

(Continued from Page 101)

Osc.: Primary 2 turns, 1 turn interwound with secondary.
Secondary 6½ turns, 16 TPI.

Band 3 (40 metres)
Aer.: Primary 6 turns 32 B and S, close wound.
Secondary 17 turns, close wound.
RF.: Primary 9 turns 32 B and S, close wound.
Secondary 17 turns, close wound.
Osc.: Primary 4 turns, 16 TPI, 2 turns interwound with secondary. Secondary 16 turns, 16 TPI.

All coils wound on ¾in dia. formers. Secondaries wound with 18 B and S enamel wire. Primaries wound with 27 B and S enamel wire unless otherwise stated. Commence 'hot' end of secondary ¾in from base end.

PARTS LIST

1 Chassis 10½in x 7in x 2½in.
1 Panel 11in. x 7in.
1 Power transformer 225V 50 mA 6.3V 2A.
1 Filter choke 50 mA.
1 3 gang tuning capacitor 10-24 pf.
1 3 x 3 x 3 rotary switch.
1 B/C aerial coil.
Dial assembly.
3 Terminals, red, green, and black.
1 Coaxial plug and socket.
9 ¾in. dia. coil formers grooved 16 TPI. Complete with base and slug.
3 30pf trimmers.
1 9 pin shielded socket.
1 9 pin socket.
2 7 pin sockets.
2 pointer knobs.
1 Medium round knob.
2 Pointer knobs.

VALVES

1 6BY7.
1 6U8.
1 6X4.

CAPACITORS.

2 16 mfd 525V electrolytics.
3 .1 mfd 400V paper.
2 .033 mfd 400V paper.
1 .001 mfd mica or ceramic.
3 100 pf 5% mica or ceramic.
4 68 pf 10% mica or ceramic.
1 50 pf mica.

RESISTORS

(All ½W unless otherwise stated).
1 220K
1 47K
1 5K 5W.
3 2.2K
1 1K
1 150 ohm.
1 10K potentiometer.

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1 7 tag terminal strip.
1 5 tag terminal strip.
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Hookup wire, power flex.
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Solder lugs.
4 Grommets.
Scrap metal for shield.

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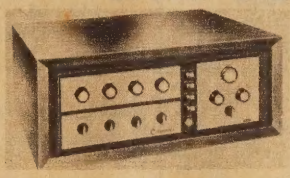

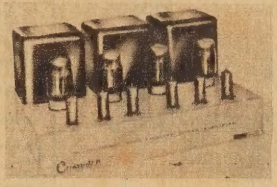

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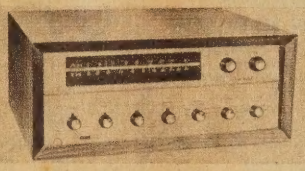

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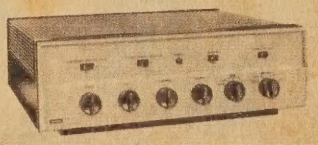

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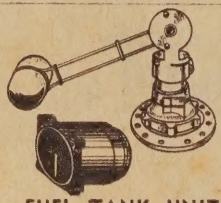

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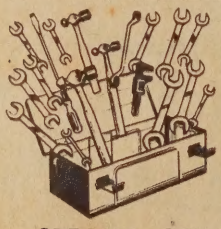

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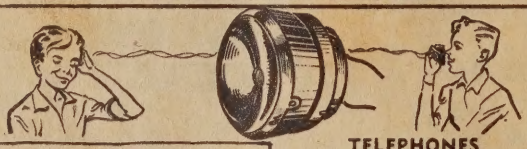
1 Ring Spanner, ¾in x 11/16in.
1 Open-end Ring Spanner, 11/16 x 13/16.
1 Ring Spanner, 11/16 x 13/16.
1 Tube Spanner, 14mm x 18mm.
1 6in Shifting Spanner.
3 BALL PEIN Hammers — 8oz, 16oz, 24oz.
1 pair 6in PLIERS.
1 15ft tow-rope with spliced loop and steel hook.
1 METAL TOOLBOX, 19in x 8in x 7in.

THE LOT FOR £6/15/6

3/- Cartage to Rail.
Freight payable at nearest attended Railway Station.



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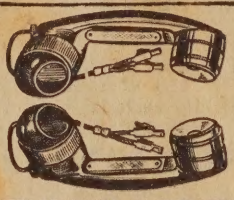

TELEPHONE HANDSETS

NEW SOUND POWERED

No battery required. Ideal television installation intercom., field telephones, etc.

55/- ea.

or £5 a pr. Post 5/-, Int. 7/6.

TELEPHONES

Sound powered, can be used as microphone or receiver, New.

38/6 Pair

Post, N.S.W., 2/6; Int., 4/.

A.W.A. COMMUNICATIONS RECEIVER

Type 2C8388. No. 24. Plug-in coils. 5 to 11 Mcs. with power supply and speaker.

£19/10/-

AIR SPEED INDICATORS

NEW.

8/6

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PERISCOPES

10in x 4in x 1¼in. Contain two front silvered mirrors, 3½in x 1¾in x 1/8in.

12/6 each

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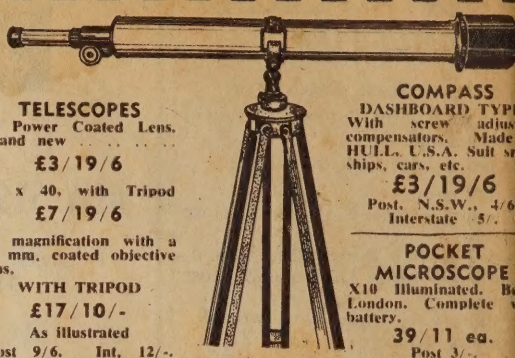
MANIFOLD PRESSURE or VACUUM GAUGE

29/6 ea.

NEW.
Post: N.S.W., 2/6; Int., 3/.



TELESCOPES

30 Power Coated Lens. Brand new . . . . . .

£3/19/6

30 x 40, with Tripod

£7/19/6

60 magnification with a 60 mm. coated objective lens.

WITH TRIPOD

£17/10/-

As illustrated
Post 9/6. Int. 12/-.

COMPASS

DASHBOARD TYP
With screw adjus compensators. Made HULL, U.S.A. Suit s ships, cars, etc.

£3/19/6

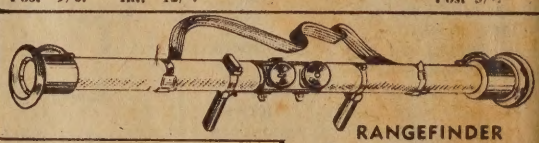
Post, N.S.W., 4/6 Interstate 5/.

POCKET MICROSCOPE

X10 Illuminated. B London. Complete battery.

39/11 ea.

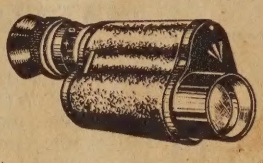
Post 3/-.



RANGEFINDER

Barr and Stroud Tubular Type. 4 ft length MK. V

£12/10/



PRISMATIC MONOCULAR

8 x 30. Ideal for Races, Football or General Viewing. This is the Monocular that is used as a telephoto camera lens. With Leather Carrying Case

£5/19/6

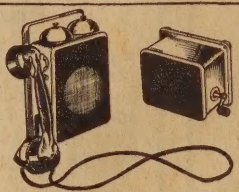
Post 4/6. Int. 6/-. . . .

FIBRE PULLEYS (AMERICAN)

BALL BEARING.

1 3/8in diam., ¼in shaft, 30/ doz.
1¾in diam., ¼in shaft, 42/ doz.
2 3/8in diam., 3/8in shaft, 54/ doz.
3½in diam., 3/8in shaft, 66/ doz.

Add postage.



TELEPHONE SETS

Ex. P.M.G. Wall-type. Complete with Magneto Box. Battery operated. Ideal long distances.

£4/15/- each or £9 pair

Freight payable at nearest attended Railway station.

Dashboard COMPASS

Small ships. Pioneer American. Liquid Damped with Light. Also suit as car compass.

£9/17/6

CHASSIS

RT24/APX2 or B/APX1 15 miniature seven-pin ceramic valve sockets and covers, trannies, etc.

45/- each

WINCHES

2-ton Dawn. New. Hand-operated. Complete with steel cable. £35. Freight payable at nearest attended railway station.

MICROMETERS

0 to 1in. Starrett, Moore an Wright.

Perfect Order. Post: 3/. **75/-** e

COMPLETE TRANSMITTER NO 15

A.W.A. type J51050 compris R.F. unit, power control and mi rectifier unit, and main rect unit, with spares. 100 watt 300 watt C.W. Crystal contro 2 to 20 megs, with power sup 110 or 240 volt A.C. 50 cy New. Will transmit over 500-r range daytime. World range ni Original cost £2,000. Heavy-c wide band aerial included.

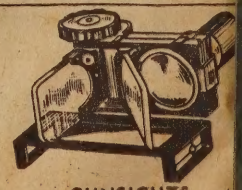
£125 COMPLETE
SECOND HAND £75 e

TELESCOPIC SIGHT

Ideal Rifle or Dumpy Level Sight.

47/6

Post, N.S.W., 3/; Int., 4/



GUNSIGHTS

Contain these lenses:
1 lens 1in Focus, ½in dian
1 Lens 1 11/16in Focus, 1¼in
1 Air Spaced Lens, 1¼in dia
1 Filter Lens, 1 Graticule.
1 Lampholder.

18/6 each

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DEITCH BROS.

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